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ABSTRACT

This handbook for teachers is designed for use as a short, self-contained program to help teachers add effective tutoring to their overall teaching program. The format of the course consists of four steps: (1) reading about new teaching skills; (2) seeing these skills demonstrated in films of actual teaching sessions; (3) practicing the skills with one or two students in a videotaped microteaching session; and (4) evaluating the videotaped performance. For each chapter, objectives, teaching skills, and a checklist of activities are given. Chapter topics include: (1) preparing for tutoring; (2) problem analysis; (3) demonstration; (4) evaluation and practice; and (5) arranging for tutoring time. (MP)

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# TUTORING IN MATHEMATICS

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## a strategy for mainstreaming

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# Lesson Objectives & Skills

**1. PREPARING FOR TUTORING**

*Objective:* to increase your skill in completing a diagnostic learning prescription for tutoring.

*Skills:* completing a learning prescription, and formulating a mastery profile for each student.

**2. PROBLEM ANALYSIS**

*Objective:* to increase your skill in identifying the student's difficulty and current mastery level in performing a math skill.

*Skills:* asking diagnostic questions; analyzing a math skill; reinforcing student responses.

**3. DEMONSTRATION**

*Objective:* to increase your skill in using demonstration techniques to help students understand abstract math concepts.

*Skills:* using demonstration techniques; reinforcing student responses.

**4. EVALUATION & PRACTICE**

*Objective:* to increase your skill in developing the student's ability to perform math skills independently.

*Skills:* assigning an evaluation problem; assigning practice examples; recording student progress; reinforcing student responses.

**5. ARRANGING FOR TUTORING TIME**

*Objective:* to increase your use of tutoring as part of your regular classroom activities.

*Skills:* implement a classroom tutoring arrangement.

# Introduction

Welcome to *Tutoring in Mathematics*, a Minicourse designed to help you add effective tutoring to your overall teaching program. During the next six weeks you will refine your professional skills by learning to use a basic tutoring strategy. At the same time you will practice this strategy with a few of your students who are having serious difficulty in mathematics. This simultaneous study-practice approach is fundamental to the Minicourse instructional format.

## THE MINICOURSE

*Minicourse* is the name that has been given to the instructional model used in this and similar teacher training courses. The name refers to a short, self-contained program that employs *microteaching* as a means of developing specific teaching skills, and provides feedback through self-evaluation rather than through supervisors.

The Minicourse format consists of four steps: (1) reading about new teaching skills; (2) seeing these skills demonstrated in films of actual teaching sessions; (3) practicing the skills with one or two of your students in a videotaped microteach session; and (4) evaluating your videotaped performance.

In microteaching, you videotape (or tape record) a short lesson that you can play back later to watch yourself interact with students, evaluate your use of the course skills, and plan a reteach lesson for

further practice. Microteaching provides the opportunity to practice a few specific teaching skills in a short lesson with only one or two students. In this course you will conduct six microteach and reteach lessons, each with one or two students at a time, and each about 15 to 20 minutes long.

## MAINSTREAMING

We have subtitled this course *a strategy for mainstreaming*. Mainstreaming simply means placing special education students in regular classrooms--in the mainstream of education--instead of segregating them in special classes. There is little research evidence that special education students make greater gains in academic achievement or social skills when they are separated from the regular classroom. Mainstreaming avoids prejudicial labelling of special education students, and provides a setting in which all students may learn from each other.

Mainstreamed students may spend the entire school day in the regular classroom, or they may be separated from other students for a brief time for special help. In either case, the regular classroom teacher is primarily responsible for the students' education. Special education personnel may be available to support and assist the regular classroom teacher.

The special education teacher in your school is taking this course with you, and will be a valuable resource person for you in the weeks ahead. This teacher already has experience in teaching students with learning problems, and will be able to provide you with constructive support as you practice new teaching skills. You can ask him to help you identify learning characteristics in your students, and to suggest curriculum materials and teaching strategies that will make

your tutoring sessions more effective and more enjoyable.

## TUTORING

Tutoring can be particularly valuable in working with mainstreamed students, simply because they often need individualized attention. Tutoring is equally appropriate for use with any other student who is having serious learning problems in mathematics. In this course you will practice tutoring skills with students who have been mainstreamed *and* with students who have not been in a special education program, but who need special help in math.

The diagnostic procedures and teaching skills in this course add up to a fundamental tutoring strategy which is appropriate in several teaching situations. Sometimes two or three students will have similar math problems; then you can apply this tutoring strategy in a small group situation. Several of the course skills also may be employed in a large group setting--skills such as those associated with questioning, providing reinforcement, and using demonstration techniques.

## COURSE SCHEDULING

*Tutoring in Mathematics (TIM)* is a self-study course, which means that you will work on your own a great deal in the next six weeks. You must coordinate your independent activities carefully if you are to complete all the necessary tasks contained in each lesson *and* meet prearranged schedules for group meetings or videotaping sessions. It is imperative that you know exactly *what* you are to do for each of the five lessons in *TIM*, because only then will you be able to plan exactly *when* to accomplish each lesson activity.

To help you organize your time, we have included a checklist of activities at the beginning of each lesson. Except for Lesson 1, which requires two weeks, each lesson takes one week to accomplish. Review each lesson's checklist *before* you begin work, and insert the dates on which you will do the lesson activities. You should plan to complete all the activities within the suggested time frame. You can cross off activities as you complete them during the week. We realize that this procedure may seem unnecessarily detailed, but it is designed to help you learn the course skills in the easiest, most effective way.

The amount of time this course requires will vary from one person to another. As a rough guide, you can expect to spend about three to four hours on each of the five lessons. This includes the time you will spend working with your students, as well as out-of-class preparation and self-evaluation time. Because *TIM* is a self-study course, however, it is also self-pacing; you are free to spend more time on a particular lesson or expand your tutoring because of student needs.

During the next six weeks try to schedule your outside activities so that they will not conflict with the course activities. You will enjoy the course more, and get more out of it, if you do not overextend your time commitments. If you do have to be out of school for a few days, or if you get behind in the lesson activities for any reason, check with your course coordinator to reschedule your activities on both the master schedule *and* your lesson checklist.

## WHY BOTHER?

One last note--as you look over the lesson skills and objectives, you may think, "This isn't anything new. I do this already." And you will be right, in a

way. Most teachers *are* already familiar with the skills taught in this course; but few teachers use these skills *consistently* as a total tutoring strategy. Our research indicates that the great majority of teachers who have taken the course and used the strategy consistently have made substantial gains in their classroom effectiveness. In addition, they discovered--as you will, too--that a Minicourse is different from any instructional training they have had before, and have found it personally and professionally rewarding.

## LESSON PLAN

**OBJECTIVE**

To learn how to complete a diagnostic learning prescription for the students you plan to tutor.

**TEACHING SKILLS**

1. Complete a diagnostic learning prescription for each student. The prescription will include:

   a. Observed learning characteristics
   b. Diagnostic math information
   c. Materials and strategies.

2. Formulate a *Mastery Profile - Math Skills* for each student.

**CHECKLIST OF ACTIVITIES**

WEEK 1

Day 1_____ Read Chapter 1 of the *Teacher Handbook*.

_____ Identify three or four students to tutor.

Day 2_____ Observe students during regular math instruction to note learning characteristics.

_____ Complete the learning characteristic portion of each Student Learning Prescription.

WEEK 2

Day 1_____ Administer informal inventory of math skills to each student in one hour of release time.

_____ Complete the math diagnosis portion of each Student Learning Prescription.

Day 2_____ Identify materials and strategies for tutoring.

Day 3_____ Meet with participating teachers at your school.

Day 4_____ Complete a learning prescription and mastery profile for each student you plan to tutor.

# 1. Preparing for Tutoring

During the next five weeks, you will learn a specific tutoring strategy to help students who have learning problems in mathematics. In this first lesson, you will learn and practice a series of teaching skills which we call *pre-active*, because they are necessary preliminaries to effective tutoring. You will not do any actual tutoring in this lesson.

Pre-active skills will help you to identify the individual learning characteristics of students who are having difficulty in math, and also to isolate their curriculum needs. At the end of two weeks you will have a *learning prescription* for each student you plan to tutor. A learning prescription is a composite of specific diagnostic information about a student. You'll use three techniques to gather this information for each prescription: (1) *classroom observations* will let you know how each student learns best and what sort of math work he has been doing recently; (2) *an informal diagnotic inven-*

*tory* with each student will give you more specific information about his math skills and his approach to problem-solving; and (3) a *meeting* to share problems and ideas with all the other participating teachers in your school. The completed learning prescriptions will help you plan your tutoring lessons later in the course, by teaching you how, in advance, how each student works best, what skills he has mastered, and how you can adapt or supplement your curriculum to fit his skills and needs.

## PREPARING A LEARNING PRESCRIPTION

The diagnostic learning prescription for each student you plan to tutor will contain three principal types of information:

1. *A diagnosis of the student's math skills--those that he has mastered and those on which he needs to work.*

2. *An identification of his learning characteristics.*

3. *A preliminary outline of instructional materials and strategies that you plan to use in tutoring.*

## Diagnosing Student Math Skills

Diagnosis is vital and pre-active to teaching, particularly in mathematics, which involves a series of progressive skills. You cannot teach, or implement a tutoring strategy until you know where a student stands on a continuum of math objectives. For example, there is no point in working with a student on step C of a problem until he understands steps A and B. Nor is there any reason to spend valuable tutoring time helping a student with a skill he already can perform. An *accurate diagnosis* of student abilities and difficulties

will help you avoid both of these common errors, and also will help you use your tutoring time effectively.

You already may have some information about the math skills of the students you plan to tutor, perhaps in the form of standardized achievement test results. However, you cannot rely solely on standardized information such as achievement test results for an accurate picture of student abilities and difficulties, because such tests are often unreliable diagnostic instruments--especially for students with learning problems.

Standardized tests demand that students complete an often overwhelming number of tasks, many of which require good reading skills, in a rigid temporal and spacial framework, and in a formal testing situation which frequently produces anxiety even in students who do not have learning difficulties. Moreover, the primary objective of most standardized tests is to give a global measure of student achievement. Therefore, they are not useful in identifying specific skill areas in which a particular student may need work--areas such as computation, measurement, logic, or problem solving.

Because of the problems inherent in using standardized tests as diagnostic tools, you probably will want to use an informal math inventory to obtain the accurate diagnosis of student math skills that you need in order to complete the student's learning prescription in this lesson.

**INFORMAL INVENTORIES OF MATH SKILLS**

An informal math inventory is simply a series of math problems of different kinds and varying degrees of difficulty, presented in an individualized setting. Its purpose is to identify a student's *specific areas*

*of weakness and strength* in computation, application, and problem-solving skills. The student's performance is not compared to any group performance standard. Rather, he works on the problems at his own pace, beginning at a point where he can be successful. Informal inventories generally avoid requiring the student to use reading skills: the administrator or teacher reads pertinent directions, and the student's tasks involve only computational skills.

**SOURCES OF INVENTORIES**

A number of inventories that test a wide range of math skills at different grade levels are available from two sources: commercial publishers and school district curriculum departments. Some widely used examples of commercial inventories are the Brueckner Diagnostic Test (Brueckner, L.J., and Bond, G. *The diagnosis and treatment of learning difficulties*. New York: Appleton-Century-Crofts, 1955), Diagnostic Tests and Self-Helps in Arithmetic (CTB, McGraw Hill), and the Key Math Diagnostic Test (American Guidance Service). These tests are administered individually or in small groups, and they contain items that yield diagnostic information concerning fundamental math skills, as well as application and problem-solving skills.

The other rich source of diagnostic instruments is school district curriculum departments. Many curriculum specialists have developed a series of diagnostic tests that is coordinated with district math guidelines and curriculum resources.

If possible, plan to use all or parts of a commercial or district diagnostic inventory during this lesson. Developing your own series of items may take more time than you wish to spend, or you may find it difficult to generate enough good items to cover the hierarchy of

skills in a problem area. District curriculum and special education personnel should be able to locate or recommend existing diagnostic material.

There are several procedures to keep in mind as you organize and administer a math inventory during this lesson.

**Pre-Administration procedures**

*1. Define the skill area you will inventory by observing the student as he works and by reviewing his recent math papers. Then choose a specific area with which he's having trouble, such as early numeration skills, addition with regrouping, or measurement in standard units.*

*2. If you decide to develop your own inventory, divide the skill area into a hierarchy of problems, from simple to complex, and formulate one or two problems for each level of difficulty. Avoid using problems that require reading skills or, if such problems are necessary, dictate them to the student. You may use a district or commercially developed inventory as a source for items.*

*3. Put the problems you have developed, or the commercial test items, on flash cards or on paper, with only a few problems per page. This method of presentation will not overwhelm the student or cause visual discrimination difficulties. If possible, plan to use manipulatives as part of a required task or as a way to solve problems.*

*4. Choose a quiet, non-threatening place to give the inventory--perhaps a table in the corner of the classroom or library. The area should be a place where*

*the student feels at ease and is not reminded of any previous testing or possible failure experiences.*

*5. Plan to administer the inventory during a time period that does not conflict with a school activity that the student enjoys.*

**Administration Procedures**

*1. Tell the student you'd like to work on some problems with him, emphasizing that you're not giving a test so he will not feel anxious. Make the situation informal by talking for a few minutes about his interests and his activities in school, or in any other way that makes you both feel comfortable.*

*2. Ask the student to work on a problem you think will be easy enough for him to solve. If he has trouble immediately, ask him to do an easier problem until you find his success point.*

*3. Encourage the student to explain what he's doing, why he started working a particular way, or how he knows what to do. You can gain valuable insight into his problem-solving skills by observing and listening carefully as he works. Respond positively to his errors by prompting him to check his work or to explain how he got an answer.*

*4. Progress through the levels of difficulty in the inventory until the student cannot do two or three consecutive problems, even with some prompting from you.*

These inventory procedures should not take more than twenty minutes. They will give you explicit information about which tasks the student can and cannot do within a specific skill area, as well as an idea of how he solves math problems and what his attitudes are toward math.

## Identifying Learning Characteristics

Students with learning problems may have special learning characteristics that will directly affect their success in a tutoring situation. Some of the learning characteristics you will observe may include strengths and weaknesses in the following areas: visual/perceptual, auditory, graphic, attention, and motivation. These characteristics are usually interrelated and vary in intensity.

Psychological terms such as *visual/perceptual or motivation* are always more meaningful when they are related to specific behaviors and skills. The following behavioral descriptions indicate the areas you'll be investigating in this lesson as you diagnose student learning characteristics.

**VISUAL/PERCEPTUAL**

- *Has good eye-sight; can focus on one problem in the midst of other problems; can recognize and discriminate objects by shape, color, and size; understands spatial relationship concepts, e.g., left/right, before/after; generally likes to work with designs, puzzles, mazes, colors and shapes.*

**AUDITORY**

- *Listens attentively, understands oral directions without frustration; can listen to and discriminate between similar sounds like fifty/fifteen; has good auditory memory; can do oral counting; likes to*

*listen to tapes, records, stories; generally has a "good ear" for sounds and music.*

**GRAPHIC**

- *Can write small-sized numerals without distortion; can write without getting tired quickly; can coordinate pencil, paper, and ruler; can write well on different surfaces, e.g., the blackboard; can draw geometric figures and shapes; generally likes to doodle, draw and write.*

**ATTENTION**

- *Can attend to one activity for an appropriate length of time; can attend to a series of activities; is not easily distracted by classroom noise or other students; is able to shift attention from one activity to another without too much prompting; remembers how to perform previously learned skills; generally is involved and alert as opposed to disinterested.*

**MOTIVATION**

- *Is willing to try new learning tasks; generally starts activities with little or no prompting; tries to complete assigned tasks; seems to enjoy being in class; doesn't come to you constantly for directions or help; generally will try new tasks and does not give up easily.*

These descriptions are phrased in positive terms in order to emphasize that every student has positive learning characteristics that can be used to strengthen his weaknesses. For example, a student may have a relatively short attention span with regard to math learning, but excels at visual/perceptual activities such as discriminating among objects or seeing spatial relationships. In this instance you might try to present math problems in some visual/perceptual context,

such as finding the answer to a problem in a maze drawn on the paper. When you capitalize on a student's strengths in visual/perceptual areas you may increase his attention span with regard to math problems.

These learning characteristics are interdependent and will be manifested in varying degrees of intensity. For example, a student may have a very short attention span and therefore become distracted and bored with an activity very quickly. He may know how to do a series of tasks, and he may understand the concepts that underlie the tasks, but his attention problem will affect his ability to complete problems that involve sequential skills.

A few detailed descriptions of students with learning problems will give you a better idea of how learning characteristics are interrelated, and they should help you to identify behaviors in your own students. Notice how each of the following students has a strength on which to build. The notations you will make on student learning prescriptions should resemble those that follow.

**DANNY**

Danny demands a lot of your attention; he constantly asks what to do or where to go for materials. He can recognize shapes and colors, and his graphic skills are adequate. He usually works on a task for only two or three minutes, gets distracted, and begins talking or playing with a friend. He makes many careless computational mistakes because he hurries through math problems. He reacts impatiently to his mistakes, erasing so hard that he tears the paper. He rewrites the problems, but his papers usually are not very neatly completed.

*Learning characteristics:*

*1. Motivation--dependent on external attention for reinforcement; low frustration tolerance; keeps trying though.*

*2. Graphics--good skills, has problems only because he hurries or gets distracted.*

*3. Attention--short attention span; highly distractible; cannot complete a series of tasks.*

*4. Strength to build on--positive motivation and good graphic skills.*

**JASON**

Jason is a quiet student who poses no behavioral problems. He doesn't seem to understand or remember oral directions; you have to go to him often to check that he's working on the appropriate materials. He seems to like your attention and help but does not demand it. He puts any answer down on worksheets sometimes, guessing wildly so he can finish his work with everyone else. He writes very small and light numerals and letters. He doesn't like to participate in oral counting games.

*Learning characteristics:*

*1. Motivation--seems to be afraid of failing but responds positively to attention and praise; wants to be successful like other students.*

*2. Graphic--very good skills that are tentative because of poor motivation.*

*3. Auditory--may have problem remembering oral directions.*

*4. Strengths to build on--attention, graphic and visual skills.*

**ROBERTA**

Roberta sometimes writes numerals that are distorted and of different sizes. She often begins adding numerals in the tens or hundreds place and sometimes puts the answer in the wrong column. She listens well to directions, likes taped exercises, and can do a series of tasks without much prompting. She's quiet in class and tries hard. She gets confused when there are more than five or six problems on a page; she doesn't know where to begin working and often writes the answers too large for them to fit in the allotted space.

*Learning characteristics:*

*1. Motivation--good, keeps trying on hard problems; reinforced by attention and praise.*

*2. Visual/perceptual--may have left/right disorientation; unable to focus on one problem among others.*

*3. Graphic--makes distorted or poorly sized numerals; could be motor skill problem or visual/perceptual problem.*

*4. Auditory--listens well, likes to listen to stories, tapes.*

*5. Strengths to build on--good motivation and listening abilities.*

## Choosing Materials & Strategies

Once you've identified some of the student's learning characteristics, the next step is to decide what curriculum materials and teaching strategies would be appropriate for use with him.

The simplest way to start is to adapt your own materials and teaching style to fit individual student needs and skills. In this way *you* are your own best resource, and you can take advantage of materials you've collected and knowledge you've gained

from previous experiences with students. In addition, use your colleagues as resources--in the group meeting scheduled for this lesson.

For example, you may decide to continue using the same kind of computation exercises you've been using, but you might want to adapt their usual format so you can present the problems differently for the student who has visual/perceptual problems. Or you may decide to use more visual and manipulative materials than you have in the past, to demonstrate concepts to the student who has auditory or graphic problems.

Here is a list of material and strategy suggestions which will give you an idea of how to adapt your curriculum and teaching strategies to fit individual learning needs. This list is not exhaustive, and you should use your imagination and experience to refine and add to it.

**FOR VISUAL/ PERCEPTUAL PROBLEMS**

- *Put only a few examples of one kind of problem on a page.*
- *Highlight important words or symbols with color.*
- *Draw lines to represent columns in computation problems.*
- *Use color to cue right/left, before/after directions in problems.*
- *Make sure student working surface is uncluttered.*
- *Give the student a mask (box cut in an index card) to focus on one problem at a time.*
- *Use graphic and audio techniques in presenting and working problems.*

**FOR AUDITORY PROBLEMS**

- *Ask only one question, give only one direction at a time.*
- *Combine listening and written work, using tape recorder and simple math tasks.*

- *Play game to practice remembering parts of a story or problem.*
- *Seat student near you; face him and establish eye contact while talking.*
- *Use manipulatives and graphic techniques in presenting and working problems.*

**FOR GRAPHIC PROBLEMS**

- *Tape numeral models to desk so student can see and trace correct shape.*
- *Have student practice writing numerals and making shapes by connecting dots.*
- *Leave lots of space for answers to written problems; write large numerals for problems and worksheets.*
- *Require a minimum of writing; use manipulative and visual techniques instead.*

**FOR ATTENTION PROBLEMS**

- *Decrease distractions by giving the student a workspace that is quiet and uncluttered.*
- *Assign short-range tasks and plan many activities to teach the same skill.*
- *Review previously learned skills and make sure student remembers them before starting new work.*
- *Work in an area that covers related skills that will group easily for better retention.*
- *Give the student a checklist of tasks so that he knows what to do next.*
- *Use praise or activities to reinforce paying attention for longer times.*

**FOR MOTIVATION PROBLEMS**

- *Assign work the student can do successfully first; then raise the level of difficulty gradually.*
- *Relate math problems to activities the student likes (sports, cooking, etc.).*

- *Use a variety of manipulative experiences to stimulate students.*
- *Give the student a choice of activities or ways to complete a task.*
- *Encourage independent working behavior with praise or enjoyable activities.*
- *Discourage overly dependent behavior by assigning tasks the student can do and by making directions simple and clear.*

Another source of adaptation suggestions is the special education or math resource teacher(s) in your school or district. A math resource teacher will be able to help you analyze and increase the effectiveness of your curriculum materials. A special education teacher will be able to help you observe and identify learning characteristics. He also will be able to suggest materials, activities and productive working situations for individual students. Other special educators within your district may be able to help you in other ways. Teachers of the visually handicapped have access to taped, tactile and large-print materials; teachers of the physically handicapped can spot and help solve problems that involve room arrangement, size of working spaces or location of materials; district curriculum centers often can locate or develop special materials you may not have in your school.

## MONITORING STUDENT SKILLS

The completed learning prescription provides the essential diagnostic information you need to begin tutoring. Then, as you work with a student and he begins to achieve mastery of certain math skills, it is equally essential to *monitor his progress*. It's likely that you already use some device to record student progress--

checks in your book grades, marks on a card, or lines on a graph. However, during this first lesson, adapt your recording procedure or institute a new mastery profile system in which:

1. *Both you and the student have a record of student progress.*
2. *Progress is defined in terms of mastery of specific skills, e.g. addition with regrouping.*
3. *Your copy of the profile includes a reminder to review old skills.*

These three points are especially important when working with students who have learning problems. First, giving a student a copy of his own special progress record is very reinforcing. A student who has not had much success in math will be pleased when he can see a list of his accomplishments, in small skill steps, pasted to his math folder or graphed on a chart he can keep. Secondly, defining progress in terms of specific skill mastery lets you and the student know exactly what skill or part of a skill you have worked on. This technique will enable you to be sure pre-requisite skills have been mastered before you move on to a new area, and will let you know which skills to review at a later date.

The third point--reviewing and providing for re-learning--is a crucial step. The descriptive phrase *roller coaster learner* often describes the learning pattern of a student who has a short or long-term memory problem. Such a student may master a skill, or even a series of skills, one week and then, a day or a week later, may not remember the skill he seemed to do so well previously. Or he may get stuck on one

part of a series of skills and not be able to proceed to the next step, even though he could do the same kind of problem the week before. So his learning curve has lots of hills and valleys--like a roller coaster track. This learning characteristic makes it important that you always review previously learned skills before you begin working in a related area.

We have developed a simple mastery profile that covers these points. Several copies of this form are included at the end of this lesson.

MASTERY PROFILE - MATH SKILLS

STUDENT Roberta DATE 9/1

| Description of Skill | Dates Mastered & Reviewed | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 10/1 | 10/3 | 10/4 | 10/7 | 10/10 | / | / | / | / | / | / | / | / |
| 1 Add + subt facts to 9 | X | X | X | X | | | | | | | | | |
| 2 Place value 1, 10, + 100 | X | X | X | X | | | | | | | | | |
| 3 Add story problems, 2 col no renaming, zero OK | | X | X | | | | | | | | | | |
| 4 Add 2 col worksheet no renaming; zero OK | | | X | | | | | | | | | | |
| 5 Add story problems, 2 col with renaming, No zero | | | | X | | | | | | | | | |
| 6 | | | | | | | | | | | | | |
| 7 | | | | | | | | | | | | | |
| 8 | | | | | | | | | | | | | |
| 9 | | | | | | | | | | | | | |
| 10 | | | | | | | | | | | | | |

This profile shows how you can use a simple format to record skill information and to remind yourself to review often. Use this model form, or adapt it to suit your students' needs or your own recording style. It is a good idea to give each student a copy of the profile you decide to use, or to encourage the students to make their own personalized progress records which they can post on their desks or math folders. The instructional film for Lesson 4 illustrates such a student recording system on a wall chart.

## REINFORCEMENT AND MOTIVATION

We have included reinforcement skills in every lesson of this course to emphasize the relationship between reinforcement and effective tutoring. Reinforcement techniques have a number of objectives in learning situations. They *motivate* the student to work and try new learning behaviors; they give the student *feedback* on the quality of his performance; they *maintain* appropriate behaviors and skills; and they have a positive effect on the student's self-concept. Students feel good when they get positive feedback about what they're doing right. When you acknowledge their small progress steps and their large accomplishments with praise or a special activity reward, students have a tendency to feel better both about themselves and about math.

Teachers have an infinite number of effective reinforcers at their finger tips: teacher attention, praise and proximity; classroom activities and privileges; and extra surprises like food or toys. These reinforcers frequently are catalogued as a hierarchy of positive events:

*Level 1 Self-reinforcers.* The learning task is self-reinforcing as the student works and as he achieves mastery of the task skills.

*Level 2 Attention reinforcers.* Praise and attention from teachers, recognition and approval from peers, grades.

*Level 3 Activity and privilege reinforcers.* Helping the teacher, free-time, time to play a game, any classroom activity or privilege the student enjoys.

*Level 4 Tangible reinforcers.* Candy, food, toys, extra objects not normally contained in the classroom.

Every classroom contains students who are operating on these different levels of reinforcement. A few students may be completely self-motivated; they are reinforced by their own pleasure and success in solving a difficult problem or completing a series of tasks. These students seldom need outside reinforcement and usually are very effective learners. Most students, however, are working on the attention reinforcement level. These students are a little less self-motivated and occasionally need teacher or peer recognition to accomplish learning tasks. A few students in a typical classroom may be working at the third reinforcement level; they need an extra push as a motivation to start working. With these students, you can make popular classroom activities and privileges contingent upon the students starting to work--completing some initial learning tasks or goals.

We advise teachers to use activity and privilege reinforcers to motivate hard-to-reach students whenever possible because most students do not need the powerful reinforcement of candy, food or toys to start working and learning. It is wise to avoid using tangible reinforcers because they are usually too expensive, too strong, and too easy to use haphazardly.

Students who have learning problems in math will most often respond to reinforcement at the *attention and activity levels*, partly because they may not have a history of success that makes math tasks self-reinforcing. Whatever the reasons for a previous lack of success, the appropriate use of reinforcement techniques, combined with the careful diagnosis of individual learning

characteristics and curriculum needs included in this lesson, will make it more probable that student motivation and performance will increase during the next six weeks.

Later lessons in *TIM* will emphasize the use of attention reinforcement--general and specific praise. If you decide, now or later, that a few of your students need an extra motivation boost, you might be interested to learn how to use activities and privileges as reinforcers in a *contingency management system*--like a token economy. Contact your school's special education teacher, or refer to the books listed below, for more information on how to initiate such a reinforcement system.

Dollar, Barry. *Humanizing classroom discipline: a behavioral approach.* San Francisco: Harper and Row, 1972.

Homme, Lloyd. *How to use contingency contracting in the classroom.* Champaign, Illinois: Research Press, 1970.

Krumboltz, John D. and Helen B. *Changing children's behavior.* Englewood Cliffs, New Jersey: Prentice-Hall, 1972.

Patterson, G. R. and Gullion, E. *Living with children.* Champaign, Illinois; Research Press, 1968.

Zifferblatt, Steven. *Improving study and homework behaviors.* Champaign, Illinois: Research Press, 1970.

## COMPLETING THE LEARNING PRESCRIPTIONS

The goal of your activities in the next two weeks is to complete a diagnostic learning prescription for each of the students you plan to tutor during the course. There are three major sections in the prescription: *learning characteristics, math skills,* and *materials and strategies.* Here is a sample of the form you will use to record diagnostic information. We have filled out this prescription for Roberta--the hypothetical student described earlier. Your prescriptions should contain similarly brief, specific comments in each section. Review this sample prescription and read through the suggestions that follow before you begin to work on your prescriptions.

**STUDENT LEARNING PRESCRIPTION**

STUDENT Roberta DATE 10/1

| Math Diagnosis | Learning Characteristics | Materials & Strategies |
|---|---|---|
| SKILLS MASTERED | VISUAL PERCEPTUAL | |
| Add + subt facts to 9 | L/R confusion, cannot focus on 1 problem on regular worksheet | Add problems w regrouping - mask on worksheet - color one's place red |
| Place value 1, 10 | AUDITORY | |
| Add without renaming only 2 col practice | good | Do taped story problems about bikes - adding + subtracting only |
| | GRAPHIC | |
| | distorted numerals, sometimes in wrong column | Tape numerals to desk - (5-9-4)-short A Mex |
| SKILLS TO WORK ON | ATTENTION | History short stories, p. 54 Do w Sandy reading |
| Review place value, go to 100, 1000 | good - series of steps or directions OK | |
| Zero concept in add | MOTIVATION | |
| Add with renaming | good - needs attention | |
| Begin metric meas | STRENGTHS TO BUILD ON | |
| | listening + motivation | |

## OBSERVING LEARNING CHARACTERISTICS

Observe your students during math time, and concentrate on one student at a time. Try to find out how he works on different kinds of problems and what activities he seems to enjoy or dislike in math. As you observe him, find some answers to the questions which follow--answers you can record on the learning characteristic portion of the prescription.

**VISUAL/PERCEPTUAL**

· *Can the student identify objects by size, color and shape; follow left/right, up/down directions; read the numbers on commercial dittoes? Does he like to work with puzzles or problems that involve geometric designs?*

**AUDITORY**

· *Can the student listen to and understand oral directions, count orally? Does he remember directions? Does he like to listen to audiotapes?*

**GRAPHIC**

· *Can the student write or print legible letters and numerals? Are his numerals correctly drawn? Does he get frustrated quickly with writing tasks? Can he draw numerals small enough to fit on commercial dittoes?*

**ATTENTION**

· *How long can the student pay attention to one activity? Can he easily shift attention from one activity to another? Is he often distracted by other students or normal classroom noise? Does he remember previously learned skills, series of skills?*

**MOTIVATION**

· *Is the student willing to try to do new kinds of problems, learn new skills? Which activities does he seem to enjoy or dislike? Does he demand a lot of your attention--in supportive or directive ways? When does he get frustrated?*

If you cannot decide how a student works best or whether he has a perceptual or an attention problem, ask the special education teacher to observe the student briefly. Together you will be able to identify the student's learning characteristics.

As you observe each student, begin to ask yourself some probing questions: Why does he dislike this activity? Why is he frustrated so often? When does he do well and seem highly motivated? Is his lack of attention *his* problem or a symptom of something else? Perhaps the real problem can be related to the kinds of teaching strategies you're using, or the nature of the tasks you're asking him to do. Answers to these kinds of questions may lead you to re-evaluate your teaching strategies and materials; you may even choose to use different or adapted techniques when you tutor. *Be sure to note all your observations on the learning characteristic portion of the student's prescription.*

During your observations, review each student's recent math papers and decide what specific math area you would like to work on during later tutoring sessions.

## ADMINISTERING A MATH INVENTORY

You will have one hour of release time to administer an informal math inventory to each student you plan to tutor. In order to take full advantage of this hour, plan to do several things before the release time: (1) decide which area(s) you're going to concentrate on. Previous observations should make this decision easy; (2) decide what problems you will use to test specific skills. We advise you to select appropriate problems from a commercial or

district inventory; (3) place the problems you've selected on flash cards or on several sheets of paper so they won't overwhelm the student; and (4) review the suggested administration procedures outlined earlier in this chapter.

During the release time, spend about 15 minutes with each student. Encourage him to explain what he's doing, and try to discover if he knows why he's working on a problem in a certain way. Remember that you want to identify some skills he has mastered as well as some skills he needs to work on.

Stop working briefly when you sense that the student is becoming anxious or distracted, and talk about unmathematical matters for a few minutes. Stop working completely if his anxiety increases, or if he cannot do two or three problems--even with your prompting.

Fill in the math diagnosis portion of the prescription at the end of the session, with the student looking on or after he leaves. It's a good idea to let the student know what you're writing down, as long as you emphasize what he knows as well as what he needs to work on.

## CHOOSING MATERIALS & STRATEGIES

After you have observed each student and diagnosed his math skills, you will be ready to complete the third and last portion of the prescription--a list of the curriculum materials and teaching strategies to use in tutoring.

Sit down in a quiet place one day after school, and slowly review the first two parts of each prescription. What have you learned about each student so far? Does he understand what he's doing when he regroups? How long can he work at one activity? Does he work better by himself or with a friend? Can he work on your

regular worksheets? How does he feel about math? What specific skills has he mastered?

Decide how you can use or adapt your materials to fit all the diagnostic information you've gathered. You might find it helpful to review the adaptation suggestions we listed earlier in this chapter. Investigate other sources also: ask your fellow teachers to share effective materials they have found or developed; or request additional curriculum material from district special education or math resource centers. We have included a list of supplementary commercial materials at the end of this handbook. *Note all your ideas on the prescriptions.* You'll have many opportunities to change your mind later or add other ideas.

## REVIEWING THE PRESCRIPTIONS

Toward the end of the second week of the course, you will meet with all the teachers in your school who are taking *TIM*. The purpose of this meeting is to give everyone a chance to review his prescriptions, talk about problems in diagnosis, and share ideas about curriculum materials and teaching strategies that might help individual students. You can give each other the benefit of your extensive individual teaching experiences.

Question and learn from each other: What worked when you had Danny last year? Didn't I see some math games in your room? Has anyone found an exciting way to practice basic addition and subtraction facts? Where can I get some attribute blocks--free? How can I arrange my room to give some students a quiet working space? Are you sure Karen has a short attention span--maybe she's just bored with what she's working on? Who has some extra workbooks?

It would be a good idea to organize a simple agenda for this group meeting. Depending upon how many teachers are involved in your school, here are some possible organizational items: (1) elect a discussion coordinator--preferably someone who has had experience working with special education students; (2) separate into small groups to talk about the prescriptions. Group yourselves according to grade level or student similarities; (3) ask outside resource personnel to attend the meeting and bring appropriate materials; and (4) revise prescriptions as you get new ideas. This is the only group meeting scheduled during the course. If it is a productive session, you might want to meet again.

Use your completed learning prescriptions to plan future tutoring lessons. But don't be surprised if you change your diagnosis of student difficulties later on, or if you want to use different materials than you have planned now. Each prescription will reflect your best ideas and information at the moment. After you've worked with a student for awhile, you may well decide to try a different teaching strategy or emphasize a different learning style. It's not possible to accurately diagnose all the dimensions of a student's learning characteristics at any one time. Work on those things you can identify and change, revising your diagnosis and strategy when you have more information.

## WHAT NEXT ?

Tear out the learning prescriptions and mastery profiles provided at the end of this lesson. Refer to the lesson checklist and begin to complete the suggested activities. Bring your completed prescriptions to the group meeting during Week 2.

## STUDENT LEARNING PRESCRIPTION

STUDENT _____ DATE _____

| Math Diagnosis | Learning Characteristics | Materials & Strategies |
|---|---|---|
| SKILLS MASTERED: | VISUAL/PERCEPTUAL: | |
| | | |
| | | |
| | | |
| | AUDITORY: | |
| | | |
| | | |
| | | |
| | GRAPHIC: | |
| | | |
| | | |
| | | |
| SKILLS TO WORK ON: | ATTENTION: | |
| | | |
| | | |
| | | |
| | MOTIVATION: | |
| | | |
| | | |
| | | |
| | STRENGTHS TO BUILD ON: | |
| | | |
| | | |

3/a

## MASTERY PROFILE - MATH SKILLS

STUDENT _____ DATE _____

| Description of Skill | Dates Mastered & Reviewed | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | / | / | / | / | / | / | / | / |
| 1 | | | | | | | | |
| | | | | | | | | |
| 2 | | | | | | | | |
| | | | | | | | | |
| 3 | | | | | | | | |
| | | | | | | | | |
| 4 | | | | | | | | |
| | | | | | | | | |
| 5 | | | | | | | | |
| | | | | | | | | |
| 6 | | | | | | | | |
| | | | | | | | | |
| 7 | | | | | | | | |
| | | | | | | | | |
| 8 | | | | | | | | |
| | | | | | | | | |
| 9 | | | | | | | | |
| | | | | | | | | |
| 10 | | | | | | | | |

## LESSON PLAN

**OBJECTIVE**

To increase your skill in identifying the student's difficulty and his current mastery level in performing a specific math skill.

**TEACHING SKILLS**

1. Ask diagnostic questions to check hypotheses about student difficulties.

2. Analyze a math skill to determine which tasks the student can and cannot perform.

3. Reinforce correct responses and student efforts to respond.

WEEK 3

**CHECKLIST OF ACTIVITIES**

Day 1_____ Read Chapter 2 of the *Teacher Handbook*.

_____ Complete the self-checking exercise at the end of the chapter.

Day 2_____ View the instructional film.

_____ Plan a 15 to 20 minute microteach lesson.

Day 3_____ Conduct your microteach lesson.

_____ Complete the microteach self-evaluation form.

_____ Plan a 15 to 20 minute reteach lesson.

Day 4_____ Conduct your reteach lesson.

_____ Complete the reteach self-evaluation form.

# 2. Problem Analysis

Effective tutoring is based on an over-all strategy designed to help you provide relevant assistance to your students in an efficient manner. This strategy, which we call the basic tutoring sequence, consists of four steps:

1. *Problem analysis*
2. *Demonstration*
3. *Evaluation*
4. *Practice*

In this lesson, you will learn about the first step--*problem analysis*--and practice it with one of the students you identified in Lesson 1. You will also learn more about the use of reinforcement in tutoring. Reinforcement is an important teaching skill that you will apply throughout every step in the basic tutoring sequence.

## USING PROBLEM ANALYSIS

The purpose of problem analysis is to identify the source of the student's difficulty and to deter-

mine his current mastery level in performing a specific math skill. It follows the more generalized diagnosis that you completed in Lesson 1, focusing on a student's problem in a specific skill area.

Problem analysis is both an initial and an ongoing phase of the tutoring sequence. It is important at the beginning of a tutoring session so that you can know exactly what difficulty the student is having with a math skill, and can begin building on what he already knows. But problem analysis is also useful whenever you need to probe the reasons for a student's difficulty or to check whether he has mastered the components of a math skill. Two major teaching skills are associated with problem analysis:

1. *Asking diagnostic questions.*
2. *Analyzing a math skill.*

## Asking Diagnostic Questions

Asking diagnostic questions serves a dual purpose. In addition to helping you find out precisely where the student is having trouble, it prompts the student to play an active role in his own learning. Diagnostic questioning stimulates the student to think about, and work on, a math problem himself, rather than being told what to do, or where he's making an error. When you encourage a student to become involved in a problem this way, he is more likely to be able to identify his own errors and work independently in the future. Three types of diagnostic questions are useful in problem analysis: general diagnostic, number concept, and reading definition questions.

*General diagnostic questions.* You can begin a tutoring session by asking a general question such as, How did you get your answer? or Show me how you added

that? or What part is giving you trouble? Follow up with other questions such as, Why did you...? or Show me how....

*Number concept questions.* If the student's difficulty is in number operations (addition, subtraction, multiplication, division), ask questions to test his understanding of number concepts such as place value, regrouping, and renaming. When appropriate, ask diagnostic questions about other important concepts in number operations--for example, the distributive property of multiplication over addition.

*Reading and definition questions.* If the student has trouble with word problems or in understanding the meaning of math symbols in computation problems, ask questions that test his ability to read problems, to define key words or symbols, and to decide which number operation to use.

The instructional film for Lesson 2 provides several illustrations of teachers using these questioning techniques in tutoring. As you will see, they ask diagnostic questions particularly at the beginning, but also throughout the tutoring session.

Let's look at each of the three types of diagnostic questions in more detail.

## GENERAL DIAGNOSTIC QUESTIONS

A student with a learning problem in math usually presents you with one of two situations. Perhaps he has worked on a problem by himself, solved it incorrectly, and cannot locate his own error, or he may be stuck on part of a problem and cannot decide how to solve it. General diagnostic questions are useful in both situations.

As an illustration of the first situation, suppose you have been working on the regrouping concept

with a student. How would you respond if he came to you with a subtraction problem solved as follows:

$$\begin{array}{r} 100 \\ -\ 48 \\ \hline 62 \end{array}$$

Since you want to determine the source of the student's error and want to involve him in thinking about the problem, you should *begin with some general diagnostic questions*. Rather than telling him what you think he did wrong, ask the student such questions as: How did you get your answer? Can you show me what you did? Could you work this example again and tell me what you're doing as you go along?

To illustrate the second type of situation, suppose that a student works on the same example but cannot reach any answer at all--not even an incorrect one. You can help this student verbalize his difficulty by asking: Will you show me where you would begin? Show me what you think you're supposed to do to solve this problem.

As the student responds to your general questioning, use the information he provides to help you formulate more specific follow-up questions. These will depend on the type of example with which the student is working, but they frequently begin with *Why did you...?* or *How did you...?* You probably will find that your teacher edition of the mathematics textbook details the understanding and skills required for each mathematical topic; using this material as a resource, you can ask specific diagnostic questions that focus on whether the student has the necessary understanding and skill to complete the problem.

**NUMBER CONCEPT QUESTIONS**

Several concepts are basic to an understanding of the number operations of addition, subtraction, multiplication, and division. Perhaps the most important of these are the base 10 numeration system, place value, regrouping, and renaming. If the student does not understand these four concepts, he may be able to perform the standard computational algorithms, but he will not understand what he is doing. For example, if you ask a student to solve

$$\begin{array}{r} 132 \\ -\ 7 \\ \hline \end{array}$$

he will need to understand three major concepts:

1. *Place Value--how in the numeral 132, the 2 stands for 2 ones, the 3 stands for 3 tens or 30, and the 1 stands for 1 hundred or 100.*

2. *Renaming--how 3 tens can be renamed as 2 tens and 10 ones.*

3. *Regrouping--how 10 ones can be regrouped (what teachers used to call borrowing or carrying) so that we can write 32 as 2 tens + 12 ones.*

When your general questioning indicates that a student is having difficulty with number operations, ask diagnostic questions that test his understanding of the concepts of place value, renaming, and regrouping. Examples of questions you might ask are: Can you give me another name for 73? What is the value of the 4 in the numeral 46? Can you show me

46, using beansticks? Why can you write 73 as six tens and 13 ones?

A student's answers to diagnostic questions such as these will reveal possible weaknesses in his understanding of number operations, particularly addition and subtraction. Use the teacher edition of your mathematics textbook or any other convenient source to help you identify the specific understandings that underlie each of the number operations.

**READING & DEFINITION QUESTIONS**

When students are having trouble solving word problems, the source of their difficulty frequently lies in being unable to read and understand the language. You should ask several types of reading and definition questions to help you identify the student's problem.

Begin by asking the student to read the problem to you. If he appears to have trouble with the vocabulary, you will know that you need to help him by defining words or by rewording the problem before you proceed.

Question him about the meaning of key words--words such as more, less, borrow, twice, half, several, etc.--so that you'll know whether he understands them.

Check to see if the student is able to organize the information in the problem so that he can select the appropriate number operation. Ask him, What do you think you should do with these numbers? or What process would you use? or How would you arrange these numbers so you can solve the problem? If you find that the student cannot select the appropriate number operation, you will develop this skill in the demonstration phase of the tutoring sequence.

Ask the student to explain the meaning of any mathematical symbols in the problem--for example, = ≠ < > x +. If he tells you that = is an equal sign, ask him what

that means *(the same as)* and have him define *the same as* in relationship to the number sentence on which he is working.

## Special Questioning Techniques

You may find that a student with a learning problem is reluctant to answer diagnostic questions at first. He may be accustomed to being told what the answer is, or where he is making a mistake, instead of being asked to think his way through a problem. Or he simply may have trouble verbalizing abstract concepts. You can help your students feel more comfortable and be more successful in answering questions by using these techniques:

*1. Ask only one question at a time, about a specific part of the problem. By doing this, you increase the chances that the student will be able to respond.*

*2. Pause before you follow up with another question or prompt. Give the student plenty of time to think about what you've asked and to answer. You may want to remind yourself to be patient by counting silently to 5 before you say anything.*

*3. Simplify and rephrase the question to refer to a smaller part of the problem if the student doesn't respond. Then pause and wait for an answer again.*

*4. Prompt if the student continues to have trouble answering. Typical prompting questions might be: And the next step is? Were you adding here? 4 and 5 are what? Could you show me what you did by drawing a picture? How many kites did you say that you had before?*

Prompting is giving a clue--not telling the answer. When you tell a student "4 and 5 are 9," he plays a passive role in learning; when you prompt with a clue, you involve him actively in thinking about the example, and can gain valuable diagnostic information from his answer. You will find prompting helpful throughout the tutoring sequence when a student can't answer a diagnostic question or is stuck on performing a computational process.

Students with learning problems will need extra encouragement to learn to respond actively in tutoring situations; but your extra time and effort will be more than justified by the independent thinking and working habits you will help to develop in your students.

**Analyzing a Math Skill**

The second major teaching skill in problem analysis is analyzing the student's performance of a specific math skill to see where he is having difficulty. Skill analysis will help you determine both the source of difficulty and the student's current mastery level.

Even simple math skills require that the student perform a complex series of abstract and concrete tasks. For example, adding two numbers such as

$$\begin{array}{r} 27 \\ +14 \\ \hline \end{array}$$

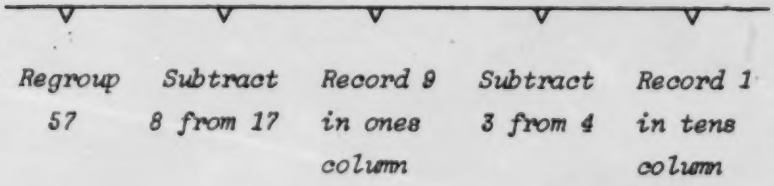
requires that the student understand the concept of addition; remember basic addition facts; understand and apply the process of regrouping; and record the sum in the correct column. And he has to perform these tasks in a special sequence. To complete a number sentence problem, such as $5 + 3 = 10 - \square$, he must understand the equal concept; know to add on one side and subtract on the other; and remember basic addition and subtraction facts.

A student with learning problems often is overwhelmed by math problems just because they involve such a series of tasks. He may know how to perform some of the steps but not remember one important step; or he may be unable to put all the steps together. At the very beginning of the tutoring procedure, therefore, you need to find out exactly which tasks the student can and cannot perform in the specific area you've decided to work on.

You can do this by breaking the skill into its component tasks and asking the student diagnostic questions to check his ability to perform the individual parts of the skill. Imagine a horizontal line on which you have arranged consecutively all of the component steps of solving a particular math problem. For example, for the subtraction problem,

$$\begin{array}{r} 57 \\ -\underline{38} \end{array}$$

your horizontal line might look like this:




You have successfully analyzed the student's ability to perform the tasks required to solve this problem when you find the steps on the line that he understands and can do. You then have identified both the tasks he cannot perform and a skill that he already understands and can use--a skill on which you can build in tutoring.

You will work with many types of math problems in tutoring, but the following examples will illustrate how to analyze a variety of math skills. Keep in mind that you will use diagnostic questioning as you work on skill analysis.

**EXAMPLE 1**

You plan to work on two-place subtraction in the tutoring session. The student has worked on subtraction before, but you're not sure what he remembers. At the beginning of the session, he has trouble with the problem (a) below. To analyze his skill in performing two-place subtraction, you might check his ability to solve the smaller parts of the problem--(b), (c), and (d).

| *(a)* | *(b)* | *(c)* | *(d)* |
|---|---|---|---|
| *53* | *58* | *23* | *53* |
| *-26* | *-26* | *- 6* | *-26* |

If the student can solve (b) correctly, he understands the subtraction process and may be having trouble with the concept of regrouping. In that case, it would be wise to go back to simple regrouping, using manipulatives and example (c). Lesson 3 will emphasize the use of manipulatives in the demonstration phase of the tutoring sequence. When the student understands the regrouping process with manipulatives, you can begin to work on the written algorithm (d). Remember to use questioning techniques to check whether the student understands why he's crossing out the 5 in the tens column and writing a new number in the ones column.

**EXAMPLE 2**

The student needs help with division, but you're not sure where he's having trouble. You think he may be

having difficulty deciding what to do with remainders, but you need to investigate further to be certain that your diagnosis is correct. Therefore, you give him the division problem (a), which he works as shown.

| *(a)* | *(b)* | *(c)* |
|---|---|---|
| $6\overline{)38}$ R 62 | *Story about problem (a)* | $6\overline{)36}$ |

His solution suggests that he may not understand the division concept or may be confused about the column in which he should place the quotient. To investigate further, you might have him tell you a story about the problem (b). If he tells a story that involves six groups of 6 with 2 leftovers, then he does understand the division concept and needs to work on the correct place-value placement of the quotient. On the other hand, if he tells you a story about sixty-two groups of 6, he needs to work further on the division concept, and it would be a good idea to go back to simple division (c), using manipulatives to demonstrate.

**EXAMPLE 3**

The student is having trouble understanding what to do with word problems. He comes to you unable to begin working on the following problem.

*Joe is 143 cm. tall. Sue is 158 cm. tall. How many centimeters taller is Sue than Joe?*

He may be having a simple vocabulary problem, or he may not know how to organize the problem information

to choose the correct number operation. To analyze the student's skills in this situation, you could use the procedures below.

| *(a)* | *(b)* | *(c)* | *(d)* |
|---|---|---|---|
| *Reading questions* | *Clue words* | *Picture of problem* | *Number sentence* |

First, you might ask the student to read the problem, checking to see whether he understands the vocabulary (a). Then you could check to see if he can identify the clue words (b), *How many centimeters taller?* and if he understands how they relate to selecting the number operation he would use to solve the problem. If necessary, you could ask the student to draw a picture of the problem (c) so that he can visualize the information. Finally, you could ask him to organize the problem information in a number sentence (d) with the appropriate operation symbol.

**EXAMPLE 4**

You ask a student to count verbally by three. He responds, *3, 6, 9, 10, 12, 14,* and stops. In analyzing this student's difficulty, you might follow these steps:

| *(a)* | *(b)* | *(c)* |
|---|---|---|
| *verbal or understanding confusion* | *Hundreds chart work* | *Missing multiples on paper* |

Your first step might be to see whether the student is confusing the multiples of 2 and 3 on a verbal level (a). It would be well to use a hundreds chart to check whether he understands the *counting on* concept (b).

Ask him to count by three on the chart by covering the numbers or by coloring them. Then when he understands the concept, you could ask him to count verbally again as he looks at the chart. Next you might have him fill in some missing multiples on paper exercises (c), checking his own work with the chart. It is wise to return to the verbal counting task eventually because verbal repetition of multiples is good preparation for learning basic multiplication facts.

## REINFORCING STUDENT RESPONSES

A third teaching skill will be important as you begin to microteach in this lesson--reinforcing correct responses and student efforts to respond.

Reinforcing students for trying hard or for being successful in solving even small parts of problems is essential in tutoring, particularly as you begin to work with a student. You can help the student feel better about himself and gain some confidence in his ability if you pay special attention to his accomplishments.

Effective reinforcement involves using two specific techniques: (1) providing specific praise and (2) avoiding negative comments.

First, verbal praise should be *specific to the student's performance*. Many teachers constantly use words such as great, good, fine to acknowledge their students' efforts. While these words can be encouraging, they also can become habitual for both teachers and students; then they lose their meaning. Instead, make an extra effort to specify in your praise what it is that the student has done well. For example, he may have struggled through reading a word problem and choosing the appropriate number operation

to use in solving it. You can express your pleasure in his work by saying something like: Great work, Danny. You read that problem perfectly, or That's right that you decided to subtract there. Good thinking. When you specify your praise, the student knows exactly what he has done correctly and is encouraged to repeat his performance in the future. Praising without specification, on the other hand, tends to leave the student uncertain about why he earned your praise.

Secondly, it is important that you *avoid negative statements*--commenting about the student's mistakes, his lack of ability, his poor work habits, or his slow rate of success. Students with learning problems usually are quite aware that they're having difficulty; your job is to build confidence and success. Doing this requires that you make a special effort. Don't compare a student, consciously or unconsciously, with other students in the class. Avoid prefacing your remarks with, No, Jim, you'd better try that again--an often unconscious speech habit.

The student you tutor may seem very restless and distractible. This usually means that he is bored or trying to divert your attention because he isn't being successful. Instead of making a negative comment, respond positively in such a situation by evaluating what you have asked the student to do. You will find more appropriate behavior to reinforce if you simplify the task he is working on or change to another kind of activity. When the student does become more interested and involved in the tutoring session, make a special effort to praise him as he begins to attend more often, as he solves even a small part of a problem.

**WHAT NEXT ?**

Check your understanding of the teaching skills discussed in this chapter by completing the self-checking

exercise which follows. Then view the instructional film for this lesson in which you will see teachers asking diagnostic questions, analyzing math skills, and providing praise for student efforts. Suggestions follow to help you plan your microteach lesson--which you will conduct after you view the film.

## SELF-CHECKING EXERCISE

This exercise will give you written practice in using the teaching skills in this lesson before you begin tutoring. Decide what you might do in each of the following situations. Then you can compare your answers with the suggested responses on the next page.

1. You are tutoring a student in subtraction. He begins the following problem and gets stuck. What questions might you ask to help him identify his trouble? What simpler subtraction problems would help you analyze his skill in doing parts of the problem?

```
 67
-19
  2
```

2. You are working with a student on word problems that involve only one number operation. You've given him the following problem, and he doesn't seem to know where to begin. What are some diagnostic questions you could ask to get him started?

*Sam has 3 records to sell at the school Christmas sale. Harry has 5 records to sell, and Danny has 8 records to sell. How many records all together did the three boys bring to sell?*

3. Mrs. Smith is working with a student on regrouping in addition. He does the following problem as shown. She responds, *No, you wrote the 13 instead of carrying the 1.* How could Mrs. Smith's response have been improved?

```
 765
+ 28
7813
```

## POSSIBLE RESPONSES TO EXERCISE

We've included only a few of the ways a teacher might respond in these situations. Decide whether your answers would help you identify the student's problem and prompt him to be actively involved in working on the math tasks.

1. Why do you think you're stuck? Show me how you got the 2 in your answer. What does this symbol mean? Can you take 9 away from 7? What place is the 9 (and the 7) in? What place is the 1 (and the 6) in? Can you show me how you'd do these problems?

$$\begin{array}{rrr} 67 & 67 & 27 \\ -13 & -\ 9 & -\ 9 \end{array}$$

2. Can you read the problem to me? Read it silently to yourself first for practice. Can you find a phrase that gives you a clue about what you should do with all the numbers? What do the words "all together" mean? Can you make a picture of the problem? Can you write a number sentence with the parts of the problem in it? *(3 + 5 + 8 = ___ ).*

3. Mrs. Smith prefaced her remark with the negative word *no* and *told* the student what he did wrong. It would have been better to have avoided the negative comment and instead asked diagnostic and prompting questions that would help the student be successful. For example: Can you check that answer for me? How about trying it again and telling me what you're doing? How much is 8 + 5? Can you tell me what the place name of the first column is? How about the second column? Can you do this problem?

$$\begin{array}{rr} 765 & \\ +\ 8 & \end{array} \quad or \quad \begin{array}{rr} 15 & \\ +\ 8 & \end{array}$$

# PLANNING YOUR MICROTEACH LESSON

For this microteach lesson, plan to tutor one student for about 15 minutes, emphasizing the teaching skills discussed in Chapter 2 and illustrated in the instructional film for this lesson. Afterwards, you will replay your videotape and complete the self-evaluation. Later in the week you will plan and conduct a reteach lesson. Read the suggestions that follow and then complete the lesson planning form.

The teaching skills you should try to practice in this microteach session are:

**TEACHING SKILLS TO EMPHASIZE**

*1. Ask diagnostic questions to check out hypotheses about student difficulties.*

- *General diagnostic questions such as: How did you get your answer? Show me what part you don't understand, How did you...? Why did you...?*
- *Number concept questions that test the student's understanding of place value, regrouping, renaming, and other relevant math concepts: Can you give me another name for 57? What is the value of 2 in the numeral 29?*
- *Reading and definition questions that test the student's ability to read word problems, define key words and symbols, and select appropriate number operations: What does this symbol tell you to do? What does the word more mean?*

*2. In questioning, keep in mind the special techniques discussed in Chapter 2.*

- *Ask only one question at a time, about a specific part of a problem, and pause before you follow up with another question or prompt.*
- *Simplify and rephrase the question when the student doesn't respond.*
- *Prompt with clues (but do not tell) the answer if the student has difficulty.*

*3. Analyze a math skill to determine which tasks the student can and cannot perform.*

*4. Reinforce correct responses and student efforts to respond.*
- *Provide specific praise that states what the student has done well.*
- *Avoid negative comments and "no" statements.*

**SELECTING STUDENTS FOR MICROTEACHING**

Select one student for whom you completed a Student Learning Prescription during Lesson 1. Depending on circumstances, you may want to use this same student in another microteach lesson. If you wish to do so, it is entirely appropriate. During the six microteach and reteach lessons scheduled for the course, you may work with any student for whom you have completed a Student Learning Prescription--and as often as you wish. If you decide you'd like to tutor additional students during the course, do so--but fill out a Student Learning Prescription for each before you tutor.

**PLANNING THE LESSON CONTENT**

Refer to your completed Learning Prescription for the student you have decided to tutor, and identify a math skill with which he needs help. Also review his most recent work in this area to update

your hypotheses about his specific learning problem.

Next, identify some examples of math problems that require the student to use the skill with which you'll be working. You may select either problems the student has solved incorrectly as part of his classwork, or new problems that you formulate especially for the tutoring session.

To begin the lesson, plan to ask general diagnostic questions that will help you check your hypotheses about the student's difficulty. Then proceed to more specific questioning, using number concept questions as appropriate. Plan how you will analyze the student's current mastery level by identifying the component tasks of the skill you're going to work on.

Although the teaching skills you'll be emphasizing in this lesson are concerned with the first phase of the basic tutoring sequence--*problem analysis*--you'll need to go beyond this step and begin to help the student progress toward *understanding* and *skill mastery*. Therefore, plan also how you may demonstrate skills and abstract concepts by using manipulatives, graphics, the number line, etc. During Lesson 3, you'll learn much more about this phase of the tutoring sequence, and you will be able to practice it more specifically. For now, rely on your previous experience in demonstrating math concepts so that you can start to help the student in this first tutoring session.

## CONDUCTING THE LESSON

We have presented realistic teacher and student behaviors in the course films by showing actual teachers and students in genuine tutoring sessions. But the filmed lessons are not *completely* typical, because in order to show you several examples of each skill, we had to eliminate some sections in which the tutoring did

not go as smoothly as expected. In reality, you may find that your tutoring sessions may not progress as quickly and smoothly as those in the instructional films.

If this occurs, you may be unable to practice all the teaching skills, or be unable to complete your tutoring during the time allotted for microteaching. Don't worry. Be happy. You'll have opportunities throughout the course to practice the teaching skills, and you can continue your work with the student in a later microteach or, if you prefer, in an off-camera session on another day.

## ARRANGEMENTS FOR MICROTEACHING

Your course coordinator will have scheduled microteaching time in a quiet tutoring room, and will have given you instructions about operating the audio or videotape recorder. Here are a few suggestions to help make the mechanics of microteaching run smoothly.

*1. If possible, be sure that the microteaching room is set up before you and the student go in.*

*2. Make a brief test tape before you begin tutoring to be sure the recorder is operating properly.*

*3. Spend about 20 minutes tutoring the student. Leave yourself at least a half-hour to evaluate your tape after the session.*

*4. Let the student stay for a few minutes during the replay. Begin to study the tape, using the self-evaluation form provided.*

## MICROTEACH PLANNING FORM

Refer to the preceding suggestions about planning your microteach lesson as you complete this form.

1. Which student will you tutor?_____

2. What math skill will you work on during the lesson? Review the student's learning prescription for suggestions.

_____

3. List a few sample problems requiring use of this skill. You may want to take them to the tutoring session.

_____

_____

4. List a few diagnostic questions you might ask in the beginning of the session.

_____

_____

5. What are the component parts of the skill you've identified?

_____

_____

6. What manipulatives or other materials might be helpful in the demonstration phase of the lesson?

_____

7. Review the discussion of providing reinforcement in this chapter. Remember to provide specific praise and to avoid negative comments.

# MICROTEACH SELF-EVALUATION FORM

The purpose of this form is to evaluate your skill in asking diagnostic questions and analyzing a math skill. While you replay your tape, make a mark in the column to the right *each time* you use one of these teaching skills.

**PART I**

| Teaching Skill | Tally |
|---|---|
| Asked a diagnostic question (general, number concept, reading, and definition questions). | |
| Paused several seconds after asking each question. | |
| Asked more than one question at a time. | |

**PART II**

Answer these questions after you have played your tape.

1. Were you able to analyze the math skill so that you could identify the student's specific problem and current mastery level? ____ YES ____ NO

If YES, make a note of your findings on the student's learning prescription.

If NO, how could you have improved your analysis of the problem? How could you have broken the skill into smaller parts? What other diagnostic questions might you have asked?

_____

_____

2. Examine your tally in Part I. Did you give the student enough time to answer a question very often? Did you ask more than one question at a time very frequently? Remember to ask only one question at a time and to pause during your reteach lesson.

## RETEACH PLANNING FORM

This reteach lesson will give you another opportunity to practice the teaching skills in problem analysis. You may continue with the same student who participated in the microteach lesson or select another student for whom you have completed a Student Learning Prescription. Since you want to practice the skills of problem analysis, however, don't continue with the same student unless you didn't analyze his problem successfully during the microteach lesson.

1. Which student will you tutor? _____

2. What math skill will you work on during the lesson?

_____

3. List a few sample problems that you will use.

_____

_____

4. How will you analyze the student's ability to perform the skill? List some diagnostic questions and break the skill into smaller parts.

_____

_____

5. What are some manipulatives or other material that will be helpful?

_____

_____

6. Note any special points you want to keep in mind--pausing, avoiding *no* statements, giving specific praise, asking only one question at a time, etc.

_____

_____

# RETEACH SELF-EVALUATION FORM

The purpose of this form is to evaluate your skill in asking diagnostic questions, analyzing a math skill, and reinforcing student efforts and correct responses. While you replay your tape, make a mark in the column to the right *each time* you use one of these teaching skills.

**PART I**

| Teaching Skill | Tally |
|---|---|
| Asked a diagnostic question: general, number concept, reading/definition questions. | |
| Paused several seconds after asking each question. | |
| Praised the student's efforts: GENERAL praise | |
| SPECIFIC praise (stating what he did well) | |

**PART II**

Answer these questions after you have played your tape.

1. Did you avoid making negative comments and *no* statements? _____YES _____NO

If NO, how could you have responded more positively to a student error that occurred during the tutoring session?

_____

2. On the whole, did you prompt rather than tell about answers or mistakes? _____YES _____NO

If NO, practice rephrasing one of your *telling* statements into a prompting clue.

_____

## LESSON PLAN

**OBJECTIVE**

To increase your skill in using varied demonstration techniques to help students understand math skills and abstract math concepts.

**TEACHING SKILLS**

1. Use appropriate demonstration techniques for skill and concept development.

2. Reinforce correct responses and student efforts to respond.

WEEK 4

**CHECKLIST OF ACTIVITIES**

Day 1_____ Read Chapter 3 of the *Teacher Handbook*.

_____ Complete the self-checking exercise at the end of the chapter.

Day 2_____ View the instructional film for Lesson 3.

_____ Plan a 15 to 20 minute microteach lesson.

Day 3_____ Conduct your microteach lesson.

_____ Complete the microteach self-evaluation form for Lesson 3.

_____ Plan a 15 to 20 minute reteach lesson.

Day 4_____ Conduct your reteach lesson.

_____ Complete the reteach self-evaluation form for Lesson 3.

# 3. Demonstration

In the preceding two lessons, you prepared to tutor by completing Student Learning Prescriptions, and then practiced the teaching skills associated with problem analysis--the first step in the basic tutoring sequence. During this lesson, you will continue to apply the teaching skills you've already practiced while paying particular attention to the second step of the sequence--*demonstration techniques*.

## USING DEMONSTRATION TECHNIQUES

Once you have identified a student's difficulty and determined what he does and does not know in a specific skill or concept area, demonstration begins. All students need to progress from the known to the unknown, from the concrete to the abstract. Demonstration helps to accomplish this progression by making mathematic abstractions tangible--by giving the student objects and representational devices that he can see, touch, hear, count, or manipulate.

The effective use of demonstration techniques is marked by two key characteristics: selection of materials and procedures that are appropriate, and provision for active involvement of the student.

First, *select techniques that are appropriate* both to the type of mathematical problem and to the student's learning style. Some students may need to touch and count objects in order to understand a concept such as regrouping. Others may find it more helpful to work with graphic representations, drawing pictures or diagrams. As you read this chapter, begin to plan how you can use demonstration techniques that are appropriate to the learning styles of your students

Secondly, *involve students actively* in using demonstration aids. Most students learn best by doing. This means you should ask a student to draw the graphics, hold and count manipulatives, or write a number sentence himself. Just as you did in problem analysis, avoid telling the student what to do. Instead, use prompting and questioning to give him clues about how to proceed. The demonstration phase of your tutoring may take longer this way, but the student will learn more, have greater success, and will be able to work more independently if he participates actively.

The five types of demonstration aids that are discussed in this chapter are: manipulatives, graphics, number line or hundreds chart, number sentence, and expanded notation.

As you read, consider the possibilities of using color with all of these aids. Color can be very effective as an identification or cuing device. For example, *red addition symbols and blue subtraction symbols* can signal a student to look at the symbols before working problems and also cue him to perform the

correct operation. *Colored numbers* in the ones place in computation problems can signal a student with left-right orientation problems to begin working on the right, with the colored numbers. *Colored chips* that the student manipulates can be utilized to demonstrate the concept of place value. As the student begins to respond to these signals, you gradually can eliminate the color cues.

**Manipulatives**

Work with manipulatives (also called concrete materials) is the best demonstration technique for tutoring students who are having computation or concept problems. Unfortunately, these materials are seldom used beyond the first three or four years of elementary school. Primary teachers automatically use concrete materials to introduce number concepts, but at the intermediate level the instructional approach often relies on verbal explanations and paper/pencil exercises. Manipulatives are particularly useful in teaching many of the math abstractions that are presented during the intermediate years.

A great variety of objects may be used as manipulatives in teaching mathematics, among them:

*abacus*
*scales*
*checkers*
*tangrams*
*geoboards*
*bean sticks*
*number cards*
*measuring rods*
*attributive blocks*
*jars and bottles*
*fraction pie-boards*
*place value counters*

If you do not usually work with manipulatives, be sure to practice using them in your tutoring sessions this week. The instructional film for this

lesson illustrates several ways to demonstrate specific concepts and skills with manipulatives. Use your own imagination to expand our suggestions.

As you plan, refer to the student's learning prescription for suggestions of materials that are appropriate to his learning style and the problem on which you'll be working. Remember to identify more than one manipulative to use in a specific problem situation so that you'll be prepared to vary the demonstration activity if one technique is not successful.

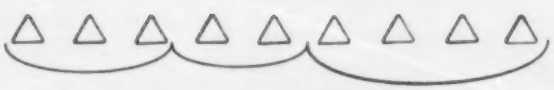
**Graphics**

Graphics are especially valuable in working with computation and word problems. Drawing a picture or diagram helps the student to visualize the key elements of a problem by making pictorial the abstract ideas represented by words and numbers. Math educators strongly recommend that demonstration with graphics be utilized both in primary math experiences, when students first learn concepts and skills, and in the intermediate years, when the concepts and accompanying processes are more complex.

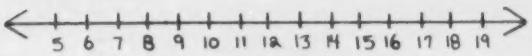
Two examples will help to illustrate how you can use graphics to help students *see* the parts of a math problem.

- *Danny has 8 marbles and Frank has 6 marbles. If each boy gives half of his marbles to Ted, how many marbles in all will Ted have?*

- *3 + 2 + ____ = 9*



The *number line* can help students understand the continuum of number values in computations that involve whole numbers and fractions. It is particularly useful in showing where numbers are in relation to each other.




$$\begin{array}{r} 19 \\ -11 \\ \hline \end{array}$$

**Number Line & Hundreds Chart**

The number line is used most often with problems involving addition and subtraction, but the teacher edition of your math textbook should contain suggestions for demonstrating other concepts and processes with the number line.

The *hundreds chart* is especially helpful in demonstrating the pattern of number relationships in the base 10 system. For example, a student can see a diagonal pattern on the chart if he adds 11 to the numbers 1, 12, 23, etc. An opposite diagonal pattern emerges is he adds 9 to the numbers 10, 19, 28, etc.

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
| 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 |
| 21 | 22 | 23 | 24 | 25 | 26 | 27 | 28 | 29 | 30 |
| 31 | 32 | 33 | 34 | 35 | 36 | 37 | 38 | 39 | 40 |
| 41 | 42 | 43 | 44 | 45 | 46 | 47 | 48 | 49 | 50 |
| 51 | 52 | 53 | 54 | 55 | 56 | 57 | 58 | 59 | 60 |

A hundreds chart also is useful to demonstrate the concept that multiplication is repeated addition. For example, a student can see that 7 x 3 is the same as 7 + 7 + 7 by counting on and coloring in

Demonstration 63

the multiples of 7 on the chart. When the student colors in multiples of 7, a distinctive pattern emerges, which helps him to visualize the multiplication process. The teacher edition of your textbook should include additional ways to use the hundreds chart in demonstrating number relationships.

**Number Sentence**

A helpful technique for developing student understanding of word problems is the number sentence. Consider the following problem:

· *You see 14 ants, and each ant has 6 legs. How many legs do you see?*

Let's assume that your diagnostic questioning has revealed that the student cannot select the correct number operation for solving this problem. Then it would be helpful to have him draw a picture of the problem situation *and* write a number sentence. You might encourage the student to draw the following picture and write the accompanying number sentence:

*14 x 6 = ____*

The first step of the demonstration process--drawing a picture of the word problem--helps the student decide what number operation to use. The second step--writing a number sentence--is a desirable tutoring technique because it helps the student see the relationship

between the quantities in the problem and the actual number operation to be performed on them. Number sentences also develop the student's understanding of mathematics as a language that is used in quantitative situations.

**Expanded Notation**

Several important ideas in number operations can be explained by the use of expanded notation. For example, if a student does not understand the concept of place value, you can illustrate it by using expanded notation.

| *Place Value Notation* | *Expanded Notation* |
|---|---|
| *43* | *40 + 3* |
| *543* | *500 + 40 + 3* |
| *1,543* | *1,000 + 500 + 40 + 3* |

Expanded notation also can be used to develop understanding of regrouping.

| | | | |
|---|---|---|---|
| *76* | *70 + 6* | *(60 + 10) + 6* | *60 + 16* |
| *-38* | *-30 + 8* | *- 30 + 8* | *-30 + 8* |

The answer is 30 + 8 or *38*.

Expanded notation makes regrouping more meaningful to the student than when he is just told to learn computation rules. As an additional demonstration aid, colored numerals can be used to indicate specific place-value notations. The teacher edition of your textbook probably contains many other illustrations of how expanded notation can be used to explain number operations.

**Reinforcing Student Responses**

It is always important to reinforce student performance in learning situations. We include reinforcement in each lesson of this course in order to emphasize its importance as a tutoring skill.

During your tutoring sessions this week, continue to use praise to reinforce partial responses, correct responses, and general responses. Remember to make your praise specific, emphasizing exactly what the student is doing correctly. Try to make your positive comments about a student response immediately after the response occurs; don't save your praise for the end of the session; reinforce positive behaviors as they occur. The various demonstration techniques you will use this week will help students be more successful in understanding math skills and concepts; success is a powerful reinforcer, too.

As you did in Lesson 2, avoid making negative comments about the student's mistakes or his ability in relation to that of other students. Use the word *no* very sparingly, and check your tutoring tapes to see if you say *no* in response to a student error. When a student makes a mistake during your tutoring sessions this week, try to take a positive approach. For example, you could say: Let's check this answer together; can you tell me what you did in this problem? Or you might say: One step in your answer needs correcting. Can you find which one?

If the student seems unresponsive during tutoring, he is probably bored or frustrated. In either case it is likely that something is wrong with the kind or amount of work you have asked him to do. Perhaps you have misjudged how long he can work on one activity. Or the demonstration technique you have decided to use may not suit his learning characteristics. If this

situation occurs, vary the activity or the demonstration technique until you find a combination that catches the student's interest and enables him to be more successful. Refer to his learning prescription for additional ideas.

## WHAT NEXT ?

Check your understanding of the demonstration phase of tutoring by completing the self-checking exercise that follows. Then view the instructional film for this lesson before you begin to plan your microteach lesson.

## SELF-CHECKING EXERCISE

Read the following situations and list some ways you could use demonstration techniques in each. When you're finished, compare your ideas with those we suggest on the following page.

1. You and the student are working on subtraction problems, and he is having trouble remembering subtraction facts. What demonstration techniques might help him understand and remember the basic computation facts?

_____

_____

2. You are working with a student on the concept of adding simple fractions, using the following problem:

*1/4 + 1/4 =* _____ .

What are some ways you could use instructional aids to demonstrate this concept?

_____

_____

3. The student you are tutoring has trouble organizing the information in word problems. What demonstration techniques might help him solve this problem?

*Sally had $4.00 to spend at the pet store. She bought one scratching post for $1.98 and three rubber bones for $.49 each. How much money did she have left?*

_____

_____

_____

_____

## POSSIBLE RESPONSES TO EXERCISE

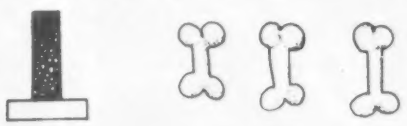
There are many ways to use demonstration techniques in these situations; we have mentioned only a few. When you look at your suggestions, evaluate how effectively they would illustrate an abstract concept for a student.

1. To help the student understand subtraction facts, you might use a number line to illustrate where numbers are in relation to each other. Or you might show him how to make a magic fact card which includes all the basic facts. To help him remember subtraction facts, you could spend some time working with number flash cards or drill games which provide practice in fast use of computation skills. Often you can arrange for classmates to drill each other with these games.

2. Manipulatives and graphics can help the student understand the concept of fractions and the meaning of the numerator and denominator. For example, you could ask the student to cut a square into four equal parts to illustrate the relationship of the parts to the whole. Then you could ask him to hold one part in his right hand and one part in his left hand. Next ask, How many parts are you holding (numerator) and what are the parts called (denominator)?

You might also use a picture of a square divided into four equal parts and ask the student to color in 1/4 of the whole and then a second 1/4 of the whole.

3. It would be helpful to ask the student to draw a picture and then to write a number sentence to organize the parts of the problem.



$1.98 + .49 + .49 + .49 = ___

has $4.00 - ___ = ___

## PLANNING YOUR MICROTEACH LESSON

The major purpose of both your microteach and re-teach sessions for Lesson 3 is to practice the teaching skills connected with the demonstration phase of the basic tutoring sequence.

*1. Use appropriate demonstration techniques for skill and concept development. Among these are:*

- *Manipulatives*
- *Graphics*
- *Number lines and hundreds charts*
- *Number sentences*
- *Expanded notation*

*As you practice demonstration techniques, remember to:*

- *Select techniques that are appropriate both to the type of mathematical problem and to the student's learning style.*
- *Involve students actively in using demonstration aids.*

*2. Reinforce correct responses and student efforts to respond, giving particular attention to making your praise specific and timely and to avoiding "no" statements.*

In addition, you will continue to apply the teaching skills you learned in problem analysis. If your Lesson 2 self-evaluations indicate that you need to improve your use of any of these skills, give them some extra attention in your pre-planning.

You may tutor any student for whom you've completed a Learning Prescription. If you'd like to work with a student for whom you did not prepare a prescription in Lesson 1, complete the form before your microteach lesson so you will be able to use materials and strategies that suit his learning needs. Tutor the same student twice this week if you are not satisfied with the demonstration technique or the progress made in the first lesson. If you work with a different student during the reteach lesson, also try to use a different demonstration technique. You may tutor two students at once during these lessons if you have two students who need demonstration help on the same skill or concept.

## MICROTEACH PLANNING FORM

1. Which student(s) will you tutor?_____

_____

2. What math skill/concept will you work on during this lesson? Refer to the student's learning prescription and to his recent papers.

_____

3. How will you conduct the problem analysis phase of the tutoring? (Although you should spend as much time as possible in this lesson on demonstration, it's useful to preplan diagnostic questions and sample problems for analyzing a skill.) You may want to write your notes on a 5" x 7" index card.

_____

_____

4. Which demonstration techniques will you use--and how? Keep in mind the need to select techniques appropriate to the type of mathematical problem and the student's learning style. Take whatever materials you will need to the tutoring room ahead of time. Try to take more aids than you think you'll need, in case some are not effective.

_____

_____

_____

5. Examine your microteach and reteach self-evaluation forms for Lesson 2. Do they suggest any teaching skills that you would like to improve during this lesson?

_____

_____

# MICROTEACH SELF-EVALUATION FORM

The purpose of this form is to evaluate your skill in asking diagnostic questions and using demonstration techniques. While you replay your tape, mark in the column to the right *each time* you use one of these teaching skills.

**PART I**

| Teaching Skill | Tally |
|---|---|
| Used a demonstration technique. | |
| Asked a diagnostic question. | |
| Paused several seconds after asking a question. | |

**PART II**

Answer these questions after playing your tape.

1. Did your use of demonstration techniques increase the student's understanding? ____YES ____NO

2. Did they illustrate the skill on which you were working and seem to fit the student's learning style? ____YES ____NO

If NO, note which technique would be more appropriate.

_____

3. Was the student actively involved in the demonstration activity? ____YES ____NO

4. How else could you have demonstrated the skill?

_____

_____

## RETEACH PLANNING FORM

As you plan your reteach lesson, review your micro-teach self-evaluation and consider how you will use any of the teaching skills on which you feel you need more practice.

1. Which student will you tutor?_____

2. What math skill/concept will you work on during this lesson? Refer to the student's learning prescription and to his recent papers.

_____

_____

3. How will you conduct the problem analysis phase of the tutoring?

_____

_____

_____

4. What demonstration techniques will you use? How? Take whatever materials you will need to the tutoring room ahead of time.

_____

_____

_____

_____

_____

_____

# RETEACH SELF-EVALUATION FORM

The purpose of this form is to evaluate your skill in asking diagnostic questions, using demonstration techniques, and providing reinforcement. While you replay your tape, make a mark in the column to the right *each time* you use one of these teaching skills.

**PART I**

| Teaching Skill | Tally |
|---|---|
| Used a demonstration technique. | |
| Paused several seconds after asking a question. | |
| Praised the student's efforts to respond: GENERAL praise | |
| SPECIFIC praise (stating what he did well) | |

**PART II**

Answer these questions after you've viewed your tape.

1. In retrospect, are there any ways in which you might have used demonstration techniques more effectively in this lesson? Base your answer on the *student's* response--on his interest, involvement, and increased understanding.

2. How did you respond to student errors and to behavior problems? Did you make "no" statements or comment negatively about his work or ability? Or did you avoid these negative statements and adapt your tutoring procedures in response to problems? Note any ways in which you'd like to change your responses in future lessons.

## LESSON PLAN

**OBJECTIVE**

To increase your skill in developing the student's ability to perform math skills independently.

**TEACHING SKILLS**

1. Assign an evaluation problem to assess the student's ability to perform a math skill independently.

2. Assign practice exercises to strengthen student skills.

3. Record student progress.

4. Reinforce correct responses and student efforts to respond.

WEEK 5

**CHECKLIST OF ACTIVITIES**

Day 1_____ Read Chapter 4 of the *Teacher Handbook*.

_____ Complete the self-checking exercise at the end of the chapter.

Day 2_____ View the instructional film for Lesson 4.

_____ Plan a 15 to 20 minute microteach lesson.

Day 3_____ Conduct your microteach lesson.

_____ Complete the microteach self-evaluation form for Lesson 4.

_____ Plan a 15 to 20 minute reteach lesson.

Day 4_____ Conduct your reteach lesson.

_____ Complete the reteach self-evaluation form for Lesson 4.

# 4. Evaluation & Practice

You've already practiced problem analysis and demonstration, the first two steps of the tutoring sequence. Problem analysis enables you to identify the source of the student's difficulty and his current mastery level. Demonstration enables you to develop his understanding of math skills and concepts. The third and fourth steps of the total tutoring sequence are *evaluation* and *practice*. The objective of both these steps is to increase the student's ability to perform math skills independently.

## USING EVALUATION & PRACTICE

Evaluation and practice are essential in tutoring students with learning problems in math. Frequently these students exhibit poor retention, short attention spans, or difficulty with conceptualization--the ability to abstract and categorize. These special learning characteristics make evaluation and practice particularly important, because such students need to gain independence and strength in math. The practice and evaluation steps encourage

the development of these qualities. In Lesson 4 you will learn three major teaching skills. They are:

1. *Assigning an evaluation problem*
2. *Assigning practice examples*
3. *Recording student progress.*

You also will continue to provide reinforcement for student efforts, and to avoid making negative types of statements.

**Assigning an Evaluation Problem**

Your purpose during the evaluation phase of tutoring is to assess the student's ability to perform math skills *without your assistance*. During the tutoring session, assign him a problem to solve that is very similar to those on which you've been working with him. It's very important that the evaluation problem you assign requires him to perform the same tasks--and only the same tasks--as those that were involved in the math problem on which you've been tutoring.

There are several ways to obtain such an evaluation problem. You can make up a new example, or you can select a similar problem from the student's textbook or workbook. If the student's difficulty was with a specific word problem, you can alter it for evaluation purposes. For example:

| *Original Problems* | *Evaluation Problems* |
|---|---|
| *1. Tom has $1.60. He wants to buy a ball that costs $2.50. How much more money does he need?* | *1. Tom has $2.30. He wants to buy a model airplane that costs $5.50. How much more money does he need?* |
| *2. 5 + ____ = 10 - 2* | *2. 2 + ____ = 8 - 1* |
| *3. 68 x 12 = ____* | *3. 47 x 12 = ____* |

Ask the student to explain what he is doing as he works on the evaluation problem. This will enable you to monitor his work, noting the steps he takes in solving the problem, the speed at which he works, and his understanding of the reasons for performing the operations.

If the student completes the problem successfully and independently, be sure to reinforce his efforts by providing specific praise. If he has difficulty--if he makes errors or simply cannot solve the problem at all--there are two procedures to use:

1. *Prompting*
2. *Recycling.*

**PROMPTING**

During evaluation, you should minimize your assistance because the purpose is to determine whether or not the student can solve the problem independently. But you may ask prompting questions to help him discover his own mistakes or to help him get started. Questions such as, Could you check that answer for me? or Are you sure that's correct? or How much is 4 - 1? often help the student discover the information he needs to continue working or to solve the problem correctly.

For example, the student may be working on this missing number sentence.

$$2 + ___ = 4 - 1$$

He has correctly written 3 above the right hand side but is not sure what number belongs in the blank. You could ask him, How did you get the 3 in your answer? and then follow up with the question, What does the equal sign mean?

As we've emphasized in previous lessons, you should give the student enough time to respond to your questions as you prompt. We also suggest that you encourage the student to use manipulatives that were helpful during the demonstration phase of tutoring.

After you've asked two or three prompting questions, the student may solve the problem successfully, and you should reinforce his efforts. But if he is unable to complete it or to find a mistake, it may be necessary to recycle him through the tutoring sequence.

**RECYCLING**

You should recycle the student through the tutoring sequence if he makes more than one or two major errors, or if you had to prompt him two or three times to help him get started or to solve parts of the problem. If this occurred, the student is not yet able to perform the skill independently. Don't be discouraged by such a situation; instead, concentrate on finding ways to help the student more effectively.

The student probably is aware of his inability to solve the problem and may be able to help you find the source of his difficulty. Ask, What do you think is giving you trouble? His response will help you see the problem through his eyes, and this procedure also has the advantage of involving the student actively in his learning process. Often the information he gives will help you re-define the source of his learning trouble, and you can begin to analyze the skill again from a different perspective.

When you need to recycle a student, be sure to evaluate your procedures carefully at each step of the tutoring sequence. Ask yourself such questions as:

- *Did I analyze the task correctly?*
- *Did I find the student's existing mastery level--the point at which he was able to be successful--before I introduced a new concept or task?*
- *Could I have used better demonstration techniques --techniques that would have been more meaningful for this particular student?*
- *Did I ask too many prompting questions?*
- *Did I give the student enough time to think about what I asked?*
- *Did I make the learning environment comfortable for the student--free from tension and from negative expectations on my part?*

Give particular thought to finding different ways to demonstrate and explain the skill on which you're working. This will require ingenuity on your part, but it's important in developing student understanding.

You sometimes may find it frustrating to repeat the tutoring procedure with the same concept or skill, but repetition is essential in tutoring students with learning problems. In some cases, you may need to work on the same kind of problem several times before a student achieves independent mastery of the skill on which you're working.

## Assigning Practice Examples

Practice, the fourth step in the tutoring sequence, logically follows evaluation. Its purpose is to give the student opportunities to use what he has learned, maintaining and consolidating his skills and building independence. Move into the practice phase of tutoring when the student has demonstrated

that he can solve the evaluation problem independently and that he understands the underlying concepts.

You should prepare several practice problems--as many as you think the student will need in order to consolidate what he has learned. These problems should be identical in form to those you have used during the demonstration and evaluation phases of tutoring, involving the same sequence of specific tasks. Each practice sheet should contain only a few problems, all of which require the use of only the skill on which you've been tutoring the student. By limiting the type and number of practice problems you require him to solve, you will avoid the possibility of confusing or discouraging the student. If he needs more practice, give him additional problems only after he has completed the first set successfully.

To build the student's confidence, have him solve one of the practice problems at the tutoring table while you observe. Reinforce his efforts and ask him to do the remaining problems on his own, either at his desk or as homework. Make arrangements to give the student help if he needs it and to provide feedback on the correctness of his work. This subject is discussed in more detail in Lesson 5; here we'll make only a few suggestions.

Some teachers schedule a few minutes between tutoring sessions when they will check students' answers to practice problems. Even though there might not be time to work with the student if he's having difficulty, this procedure lets him know how he's doing and alerts you to any problems that you need to work on in your next tutoring session.

Involving peers in practice work is another useful procedure and helps to strengthen the math skills of

*all the students* involved. Students can play math games together, correct each other's papers, or give each other practice quizzes.

**Recording Student Progress**

At the end of each tutoring session, be sure to record the procedures you used and the student's progress. If you have not completed the tutoring sequence in a single tutoring session, this record will remind you where to begin next time. If you have completed the tutoring sequence, you should record the specific skills the student has mastered. You might continue to use the Skill Profile from Lesson 1 for this purpose, or you might use a graph or chart on which the student can record his own progress. This allows him to see a picture of his achievement and reinforces his feelings of success--as well as giving him practice in the skill of measurement.

Refer to these records at the beginning of the next tutoring lesson, *before* you begin to work. Check to see whether the student remembers the skills he has learned previously by giving him an example of the same type of problem and asking him to explain the procedure as he solves it. It's often necessary especially after weekends or holidays, to have a review lesson before you begin to work on another skill. This can be done by giving a short demonstration followed by an evaluation problem.

**WHAT NEXT ?**

Next, complete the self-checking exercise that follows. Then, after you've viewed the film for Lesson 4, plan and conduct your microteach and reteach lessons, using the suggestions that follow.

## SELF-CHECKING EXERCISE

Read each of these situations and answer the questions. When you've finished, compare your answers with the suggestions on the next page.

1. Mr. Bradley has been tutoring Ellen on word problems. The original problem with which Ellen had difficulty was:

*Bill has 4 packages of chewing gum. There are 5 sticks of gum in each package. How many sticks of gum does Bill have all together?*

Mr. Bradley gives Ellen the following evaluation problem. Decide whether or not you think it is appropriate. If you think it can be improved, change it as necessary.

*Jim and Linda each have 3 model airplanes. There are 4 motors on each airplane. How many motors are there in all?*

_____

_____

2. You have been tutoring Dick, who originally had trouble with this problem:

$$\begin{array}{r} 62 \\ +18 \\ \hline \end{array}$$

During analysis you discovered that Dick did not understand the concept of regrouping. Now he is working on an evaluation problem which he's solved as follows:

$$\begin{array}{r} 57 \\ +14 \\ \hline 61 \end{array}$$

What would you do next? _____

_____

_____

## POSSIBLE RESPONSES TO EXERCISE

1. Although the evaluation problem requires Ellen eventually to perform the same number operation as in the original problem (4 x 5, 6 x 4) arranging the numbers in this form requires an additional step in the evaluation problem. It actually requires her to perform two operations:

$$3 + 3 =$$
$$6 \times 4 =$$

This additional step makes the evaluation problem much more difficult and therefore inappropriate. Thus, Mr. Bradley might have prepared this evaluation problem:

*Jim has 3 model airplanes. There are 4 motors on each airplane. How many motors are there all together?*

2. You might begin by prompting, Would you check your work? If Dick did not find this error, you might prompt again, How did you get the 6 in your answer? If he then finds his mistake and can explain why the 6 should be a 7, he may understand the concept and be able to perform independently. You could check by quickly presenting a second evaluation problem. If he could solve it without prompting, you could assign practice problems.

If, however, Dick still could not solve the problem correctly after your prompting, you would need to recycle him through the tutoring process, giving particular thought to finding different ways to demonstrate the concept of regrouping in addition.

## PLANNING YOUR MICROTEACH LESSON

During both your microteach and reteach lessons this week, plan to use the total tutoring sequence--problem analysis, demonstration, evaluation, and practice. Particularly try to apply the teaching skills discussed in Chapter 4:

1. *Assigning an evaluation problem*

- *Prompting to a limited amount*
- *Recycling the student through the tutoring sequence if necessary*

2. *Assigning practice examples*

3. *Recording student progress.*

Be prepared for the possibility that your student will need to work on more practice examples than you had expected. You also may need to demonstrate a specific skill in more than one way. Therefore, prepare copies of extra problems that the student can work on during the various stages of the tutoring session, and also identify at least two techniques that could help your demonstrate the concept or skill. Refer to the student's learning prescription to see whether graphic, audio, or visual demonstration techniques would be appropriate for his learning characteristics.

If the student is unable to solve a problem independently toward the end of your microteach session,

ask yourself some probing questions to discover where the problem might be--before you plan how to work on the same skill again:

- *Did I ask too many prompting questions or not give the student time enough to answer?*
- *Was the evaluation problem similar to the ones on which we had been working?*
- *Did I simplify the skill correctly and add new tasks in small skill steps?*

If you should be unable to get beyond the demonstration step in your microteach lesson because the student works slowly, tutor him again for the reteach lesson. This will insure that you have a chance to apply the Lesson 4 skills in the reteach lesson. If, on the other hand, you are able to complete the tutoring sequence during microteaching, you may select a second student for your reteach lesson. The lesson planning form on the next page will help you prepare for your lesson.

## MICROTEACH PLANNING FORM

1. Which student will you tutor?_____

2. What math skill will you work on during the lesson? Refer to your planning forms from previous lessons and to the student's learning prescription to identify a skill that you think he may be able to perform independently after a few minutes of problem analysis and demonstration. (This will increase your chance of being able to practice the total tutoring sequence.)

_____

_____

3. What demonstration techniques will you use? Remember to take the aids you'll need to the tutoring room in advance.

_____

_____

_____

4. What will be your evaluation problem for this session?

_____

_____

5. Make a form or chart to help you and the student record his progress. You may use the Skill Profile presented in Lesson 1 or another recording method you have found to be helpful. Have a copy of the form available for the student.

6. Prepare on a separate sheet of paper a few practice examples that you can give the student if his performance during the evaluation phase demonstrates that he is ready to practice the skill independently.

## MICROTEACH SELF-EVALUATION FORM

The purpose of this form is to evaluate your skill in using the entire tutoring sequence. View your videotape, noting any teaching behaviors that you would like to change in your reteach lesson. Then answer the questions below.

1. Was the student able to solve the evaluation problem? If not, or if he required a good deal of prompting, think about the possible reasons:

- Was the evaluation problem itself appropriate?

- Is it possible that you did not accurately identify the specific source of the student's original difficulty?

- In retrospect, were the demonstration techniques you used appropriate? Did they really help the student to understand?

- Did you perhaps rush through the problem analysis and demonstration steps so you'd have time for evaluation? If so, you might have felt some time pressure because you were microteaching, but it is critical to allow enough time to work at the student's pace in classroom tutoring situations.

Note any points which you need to remember in your next tutoring session.

_____

_____

2. If you prompted while the student was working on his evaluation problem, did you give him enough time to respond? Did you avoid offering so many prompts that he had no chance to demonstrate his progress toward independence? Note any changes you want to make in your prompting technique.

_____

_____

## RETEACH PLANNING FORM

Refer to your microteach self-evaluation as you plan this lesson.

1. Which student will you tutor? If you didn't have time to get beyond the demonstration step in your microteach lesson, tutor the same student again.

_____

2. What math skill will you work on during the lesson?

_____

_____

3. What demonstration techniques will you use?

_____

_____

_____

4. What will be your evaluation problem for this session?

_____

_____

_____

5. Prepare a form on which you will record this student's progress, and have a copy available for the student.

6. Prepare on a separate sheet of paper a few practice examples that you can give the student if his performance during the evaluation phase demonstrates that he is ready to practice the skill independently.

## RETEACH SELF-EVALUATION FORM

The purpose of this form is to evaluate your skill in using the entire tutoring sequence. View your videotape and then answer the questions listed below.

1. If you had tutored this student in a previous lesson during the course, did you begin this lesson by checking to see whether or not he remembered the skills he'd learned before? ____YES ____NO

2. Thinking of the lessons as a whole, would you judge that the student was actively involved in learning?

____Very involved ____Somewhat involved

____Not involved

If you checked not involved, think of ways you can encourage greater student participation by your use of question and of demonstration techniques.

_____

_____

_____

_____

3. Was the student able to solve the evaluation problem independently? ____YES ____NO

If YES, did you have him do one practice proolem independently? ____YES ____NO

If NO, did you ask him what he thought was giving him trouble as a prelude to recycling him through the tutoring sequence? ____YES ____NO

## LESSON PLAN

**OBJECTIVE**

To increase your use of tutoring as part of your regular classroom activities.

**TEACHING SKILLS**

1. Implement a classroom tutoring arrangement that is appropriate to your needs and will expand the amount of tutoring provided your students. Three major approaches are:

   a. Identifying and training other adults or students to share tutoring responsibilities.
   b. Increasing your own time for tutoring by the activities you assign students.
   c. Initiating a team teaching arrangement.

WEEK 6

**CHECKLIST OF ACTIVITIES**

Day 1_____ Read Chapter 5 in the *Teacher Handbook*.

Day 2_____ Review your existing instructional procedures and implement at least one arrangement to facilitate tutoring students with learning problems.

# 5. Arranging for Tutoring Time

By now, you have practiced the entire basic tutoring strategy. As you continue to apply this strategy in your classroom, you will provide the additional help that students with learning problems require. These students often are lost in a regular large group instructional setting, and need more time and attention than their peers generally do. With tutoring you provide this extra attention on an individualized basis so that each student can develop understanding, and strengthen his math skills.

You can find time to tutor in the midst of a regular teaching schedule by involving other people in various aspects of tutoring. This chapter suggests three major approaches.

1. *Identifying and training other adults or students to share tutoring responsibilities.*
2. *Increasing your own time for tutoring by the activities you assign students.*
3. *Initiating a team teaching arrangement.*

None of the techniques suggested here is novel; you probably already use some of them informally in your classroom. As you read this chapter, therefore, think about which of the procedures might add a new dimension to your classroom and help you find increased time for tutoring. You may well decide to adapt our suggestions, or you may think of an entirely different approach you'd like to try.

## IDENTIFYING & TRAINING OTHER TUTORS

Perhaps the most valuable way to provide more tutoring in your classroom is to share the responsibilities for tutoring with other adults or students--parents, paraprofessionals, peers and older students who would like to become involved in tutoring. You can find a great deal of capable assistance from these sources.

To be sure that they are able to help your students effectively, you will need to train these people in the critical tutoring procedures. Specifically:

- *Explain the key procedures they are to follow such as how to react to student mistakes, questioning and prompting with clues rather than telling, using demonstration techniques, praising correct answers and efforts to respond, and asking the student to work a problem independently at the end of a session.*

- *Demonstrate good tutoring procedures by having the people who help you observe a couple of your tutoring sessions.*

- *Check their understandings of how to tutor, perhaps by asking them to outline for you the key steps they are to follow.*

You'll probably also want to instruct your assistants to record the results of each tutoring session so that you can check the student's progress yourself and redefine the math skills on which he should be tutored next.

## INCREASING YOUR OWN TUTORING TIME

Another way to create tutoring time is by organizing classroom activities so that you are free to work with individual students. There are a number of ways in which you might accomplish this: three specific techniques are discussed here.

### Provide Students with Scoring Keys

*1. When students check some of their own math work, you not only gain tutoring time, but also the students receive prompt feedback on their performances. For students with learning problems, a self-checking exercise has the additional merit of helping to decrease fear of failure. Consider these procedures if you decide to provide scoring keys:*

- *Give all students keys for checking some of their math assignments--not just those you are tutoring.*
- *Set up a correction center with keys and scoring pencils and instruct students to go there after they've solved their assigned work.*
- *Avoid problems of copying answers by supplying partial keys that give answers for a few examples and by specifying when the work is for practice and won't be graded.*

### Have Aides or Student Monitors Check Math Work

*2. An alternative procedure is to give the scoring keys to a teacher aide or to student monitors. If you adopt this technique:*

- *Change student monitors frequently to avoid developing a small clique of favored students.*

- *Instruct monitors to mark correct answers only; the student should then recheck his work on the other problems himself.*
- *Ask students to have their work checked no more than twice during a work period, perhaps once when they've completed a couple of problems and again when they're almost finished. They should not pester monitors or aides for single answers.*
- *Collect student papers at the end of a work period and review them to keep yourself informed about student progress.*

**Assign Seatwork When You Tutor in a Special Area**

*3. As you incorporate tutoring into your ongoing classroom activities, you will need to establish a specific tutoring area at a desk or table where you and the student can work comfortably and where you can use demonstration aids conveniently. Teachers schedule their use of a tutoring area differently, but one approach is to assign seatwork for the class to complete while you are tutoring. While these assignments might be in math--especially for students who have practice problems from previous tutoring sessions--they can equally well involve any curricular area in which individual work is appropriate.*

During your time in the special tutoring area, you can either conduct a complete tutoring sequence with two or three students, or you can assist individual students with assigned seatwork. Be certain to use the tutoring area to work with *any student* who needs assistance, working with those who require only occasional help as well as those with more serious learning problems. This will avoid giving students negative feelings about coming to the tutoring area for help.

## INITIATING A TEAM TEACHING ARRANGEMENT

Whether or not your school is using some form of team teaching, you can work out an informal cooperative teaching plan with one or two other teachers who also want to tutor in math.

You might arrange once or twice a week for one teacher to present a large group lesson to the combined classes while the other teacher tutors individual students. The lesson might be concerned with math, but it also could deal with any other curricular area in which a common lesson would be appropriate. Often, for example, two classes will be scheduled to view the same social science or science film. Rather than showing the film to the classes separately, you can bring the students together with one teacher and thereby gain tutoring time for the other.

## GETTING STARTED

By examining your present instructional procedures, you probably will be able to identify other ways that you can provide increased tutoring for students with learning problems. Discuss the possibilities with your colleagues and share your ideas.

As your final activity for this Minicourse, begin this week to incorporate tutoring into your regular classroom schedule. In particular, establish a tutoring center where you will keep demonstration aids and student progress records, and where you can work with students individually. In addition, try to identify at least one organizational arrangement that you can implement immediately so that you can continue the tutoring you have already begun during this course. If you decide to train parents, aides, or peers to tutor, look over the training suggestions listed earlier in this chapter.

## FOLLOW-UP LESSONS

Our research studies show that most teachers who take the Minicourse make significant improvements in their tutoring skills. However, you know from your own teaching experience that acquired skills tend to dissipate over time unless they are practiced. Therefore, plan some activities to help yourself maintain and strengthen your tutoring skills in the months ahead.

For example, begin follow-up activities about a month after you complete Lesson 5. Plan to check yourself once on each of the four steps of the tutoring sequence, and once on your use of the total tutoring strategy. Each lesson should require only about a half-hour of your class time. Schedule these five review sessions to suit your convenience.

## Procedure

The procedure for follow-up lessons is similar to the microteach procedure you have practiced already, except that you will not have release time. Here are some procedural suggestions for follow-up lessons:

1. *Obtain audiotape or videotape equipment to record your lesson.*
2. *Plan an activity that will keep your other students working independently while you tutor. You can ask an aide or student monitor to help students who have problems.*
3. *Read the chapter of this handbook that covers the specific tutoring step you would like to practice. Also review the evaluation forms at the end of that chapter.*
4. *Choose one or two students to tutor.*
5. *Tutor for about 10 minutes, in a corner of your classroom.*
6. *Play back the tape and evaluate your use of the tutoring skills specified on the evaluation form.*

# Appendix

## MAINSTREAMING & MATH TUTORING

This review summarizes some of the developments that indicate the need for a Minicourse to help teachers use tutoring as a strategy for mainstreaming. Obviously, a brief review cannot thoroughly cover this topic, but the bibliography at the end will guide further reading if you are interested in pursuing the subject in more depth.

### WHY MAINSTREAMING?

Mainstreaming is a movement to return mildly handicapped students from self-contained special classes to the *mainstream* of regular classes. It is increasingly becoming a reality in the nation's schools.

In a mainstreamed program, students who formerly would have been placed in self-contained special classes are partially or totally integrated into regular classes. While the student may be pulled out of the regular class for a short time for individual or small group work with a specialist teacher, he is kept in the regular classroom for the greater part of the school day. *In principle, mainstreaming*

*is a direct reversal of the practice of segregating special students in their own classes.*

Philosophically, mainstreaming is based on the premise that all children, including the handicapped, are learners; that regardless of their handicaps, they are at all times ready and able to learn. Failure to recognize handicapped students' potential for learning tends to produce practices that are potentially damaging to them. All too often, there is a tendency to fit these students into neat categories with described characteristics, to adopt lower expectations for their learning potential, and to explain away their failings in the educational program by pointing to their limitations. Mainstreaming acknowledges the handicapped student's potential as a learner, and reflects a committment to the classroom teacher's responsibility for his education.

In the past, by contrast, educators generally have argued that since some students repeatedly fail in regular classrooms, they should receive special education services--typically, instruction in self-contained, segregated classes. But as more and more students have been segregated from the mainstream of education, educators have become increasingly uncomfortable. As Edwin Martin, Deputy Commissioner for Education of the Handicapped, U.S.O.E., recently remarked, *the out-of-sight/out-of-mind syndrome* began to develop. In many instances, special classes have become a dumping ground for the unwanted and troublesome, many of them students from low income families and racial minorities (Dunn, 1968; Havighurst, 1964, Erdman and Olson; 1966). Moreover, questions have begun to arise about the efficacy of special classes for students with learning problems. Research has failed to provide conclusive evidence that the more segregated and restrictive environment of the

special class leads to greater social and academic growth (Johnson, 1962, MacMillan, 1971).

In view of the lack of supportive evidence, why have special classes proliferated? One suggestion is that special classes are the result of the "regular school's failure to cope with individual and collective differences" (Johnson, 1969, p. 245). Another is that special education teachers have viewed their students as a *territorial imperative* and refused to abandon an enterprise in which they have invested so much time and energy (Ferrald and Schamber, 1973).

Regardless of the reasons, educators have become increasingly disenchanted with segregation of the handicapped. The public also has voiced its displeasure, through litigation against district and state boards of education for failure to provide "the opportunity of an education...(which) must be made available to all *on equal terms*" (Brown versus Board of Education, 1954). Many lawsuits have been settled in favor of handicapped children (Abeson and Weintraub, 1973), with the result that their civil rights are becoming recognized. These rights include the right to a free public education, the right to an education appropriate to the child's needs, the right to treatment and therapy services according to the child's disability, and the right to the least restrictive educational environment. The last is especially significant as a forerunner for the mainstreaming movement. It means that handicapped children must be placed in a *normal* educational environment, and that no child may be removed from the mainstream of education without good reason and due process.

Against this background of support for mainstreaming a word of caution is necessary. Mainstreaming is not appropriate for all handicapped children; certain students with severe or multiple handicaps are best served in a more secluded environment. Nor is mainstreaming a panacea. While many educators (Kirk, 1950; Cruickshank, 1948; Siegel, 1969; MacMillan, 1973) believe that some marginally handicapped children can and should be educated in regular classes, they emphasize that the regular classroom teacher must be supported in diagnosing and prescribing for special learning difficulties. The success of mainstreaming, as of teaching in general, rests on the confidence, committment and competency of the teacher.

## MAINSTREAMING MODELS

At present, all 50 states have laws providing some kind of educational services for handicapped children. Seventeen states have laws which provide free public education to all handicapped children. Ten states use a combination of laws and executive decrees to encourage the integration of handicapped children into local schools. Table 1, which follows this review, summarizes state laws for handicapped students.

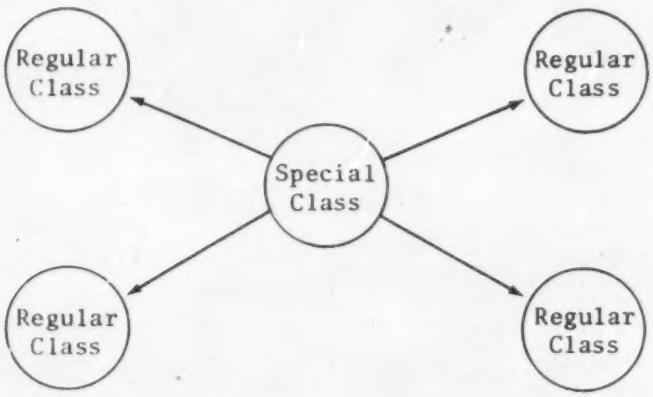
At the local level, districts have implemented mainstreaming in a variety of ways. In a study of eight California school districts in which mainstreaming has been attempted, Guerin and Szatlocky (1974) identified three major methods for integrating handicapped students. Their models are presented here with minor alterations.

### Model 1: Programmed Partial Integration

Figure 1 on the next page depicts the Programmed Partial Integration Model. In this model, all handicapped students are assigned to the special education teacher in a special class. The special education

teacher is essentially responsible for negotiating with regular classroom teachers to receive individual or small groups of handicapped students for specific blocks of time.

FIGURE 1




Initially, handicapped students may be integrated in non-academic subjects such as art, physical education, and home economics, but many programs have integrated individual students for instruction in academic subjects such as reading, math, or social studies.

**Model 2: Combined Class**

Figure 2 depicts a model in which all handicapped children are integrated into regular classes for the entire school day.

FIGURE 2

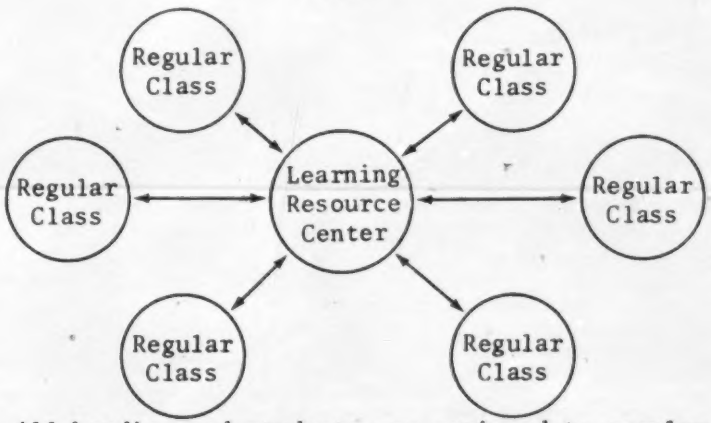
In this combination class model, each classroom teacher takes from three to six students. The special

education class is abolished completely in this model, and the funds formerly used to support a special classroom are spent to provide supplementary aids and materials and, in some cases, to hire an itinerant special education teacher who serves all regular classes within a geographical area.

**Model 3: Learning Resource Center**

Figure 3 depicts the Learning Resource Center Model in which several classes (as few as two or as many as six) are served by a resource center. In some cases, the center may be the former special classroom converted to a resource center, or it may be physically joined to several regular classrooms to form a complex of classrooms that open to the resource center.

FIGURE 3




All handicapped students are assigned to regular classes. During the day, they, as well as other students, are sent to the Learning Resource Center to receive one or two hours of instruction by the resource teacher(s). Often these resource teachers are former special education teachers, but in this model their role is to serve *all students* in the complex who have learning difficulties. They provide diagnostic, prescriptive, and tutoring services to the students as well as help the regular

classroom teacher in planning and evaluating instruction, and identifying students who need special instruction in specific subject areas. The Center often contains a variety of instructional aids, books and materials displayed in learning for reading, math, and other subjects. The funds that formerly supported the special education class are used instead to pay salaries of Resource Center teachers and, in some cases, to purchase materials.

## TUTORING AS A MAINSTREAMING STRATEGY

For mainstreaming to be successful, regular classroom teachers need to be prepared to work with students who have learning problems. The research literature indicates that tutoring is one of the most effective strategies available to teachers.

Reviews by Bernstein (1959) and by Rosenshine and Furst (1969) support the value of directed, structured tutoring in improving pupil achievement in a number of subject areas. In the specific area of mathematics, studies also tend to support the use of tutoring. These studies have been conducted with low achieving elementary students (Glatter, 1967; Dougherty, 1962; Harvey and Kyte, 1965; Pace, 1961), with low achieving junior high school students (Bernstein, 1956; Callahan, 1962),with neurologically handicapped (Zedler, 1968; Newborg, 1971), and with the educable mentally retarded (Stowitschek and Hofmeister, 1974; Jenkins *et al*, 1974).

Teachers, however, tend not to engage in tutoring activities and those who do tutor tend to do so poorly. Borg (1970) found that the typical tutoring interaction is deficient in two major respects: it is too short, and it consists primarily of just telling the pupil his errors. Studies reviewed by Gall (1974)

show that teachers untrained in tutoring make relatively little use of diagnostic and demonstrating techniques and rarely evaluate and monitor student progress.

When teachers receive training in these tutoring techniques, however, they do become proficient in their use; increases in student achievement in mathematics result (Stowitschek and Hofmeister, 1974). The findings of Stowitschek and Hofmeister are of particular interest because they studied the effects on teacher training in tutoring through an earlier version of this Minicourse *(Individualizing Instruction in Mathematics, 1971)*. The participating teachers and their students were from educable mentally retarded classes at the elementary, junior high, and senior high school levels. The researchers found a positive change in pupil achievement in mathematics, and established its relationship to their teachers' acquisition of certain specific tutoring skills presented in this Minicourse.

Thus, it appears that tutoring in mathematics by teachers who are skilled in a specific tutoring sequence is an effective strategy for working with mainstreamed students.

# STATES WITH COMPREHENSIVE LEGISLATION & EDUCATION SERVICES FOR HANDICAPPED CHILDREN

| State | Mandatory right to education legislation | Implementation date | Legal age | Legislation with mainstreaming provisions | Legislation with provisions for planning |
|---|---|---|---|---|---|
| **1971** | | | | | |
| Michigan | Public Act #198 | 7-1-72 | birth - 21 | Yes | State/Local |
| **1972** | | | | | |
| Illinois | HB 323 & HB 322 | 7-1-72 | 3 - 21 | No | Local |
| Louisiana | Act #306 | 1973-74 | 3 - 21 | Yes | No |
| Massachusetts | HB 6148, Ch. 71B | 9-1-74 | 3 - 21 | Yes | Local |
| New Mexico | SB 14, Ch. 95 | 7-1-72 | 6 - 21 | Yes | State |
| South Carolina | Act #977 | 2-14-72 | 6 - 21 | No | Local |
| South Dakota | Act #108 | | birth - 21 | No | No |
| Tennessee | HB 2053, Ch. 839 | 7-1-72 | 3 - 21 | Yes | State/Local |
| Virginia | SB 132 (HB 770) | 7-1-73 | 2 - 21 | No | Local |
| **1973** | | | | | |
| Arizona | HB 2256, Ch. 181 | 7-1-75 | 5 - 21 | Yes | No |
| Arkansas | Act #102 (SB 19) | 7-1-73 | 5 - 21 | Yes | State |
| Colorado | HB 1060; HB 1184 | 7-1-75 | 5 - 21 | Yes | Local |
| Maine | HB 751 | 10-1-73 | 5 - 20 | Yes | State/Local |
| Maryland | SB 649, Ch. 359 | 7-1-73 | birth - 20 | Yes | Local |
| Mississippi | HB 74 | 7-1-73 | birth - 21 | No | No |
| Missouri | HB 474 | 7-1-74 | 5 - 21 | Yes | Local |
| Nebraska | LB 403 | 7-1-74 | | No | Local |
| North Dakota | HB 1090 | 7-1-75 | 6 - 20 | No | Local |
| Ohio | SB 405 | 7-1-73 | birth - 21 | No | State/Local |
| Wisconsin | SB 185 | 8-9-73 | 3 - 21 | Yes | Local |
| **1974** | | | | | |
| California | AB 4040 | pending | 3 - 20 | Yes | State/Local |
| Iowa | SF 1163 | 7-1-75 | 5 - 21 | Yes | Local |
| Kansas | HB 1672 | 7-1-74/7-1-79 | birth - 21 | Yes | State |
| Montana | HB 388 | 7-1-74 | 6 - 21 | No | No |
| New York | SB 8501 | pending | 3 - 21 | Yes | |
| North Carolina | HB 1814, Ch. 1293 | 7-1-74 | 5 - 18 | | Local |
| Ohio | SB 954 & HB 858 | pending | | | |
| West Virginia | HB 1271 | 7-1-74 | 5 - 23 | Yes | |

Additional states with some form of mandatory legislation include: Alabama, Alaska, California, Connecticut, Delaware, Florida, Georgia, Hawaii, Idaho, Indiana, Kentucky, Minnesota, New Hampshire, New Jersey, Oklahoma, Pennsylvania, Rhode Island, Texas, Utah and Wyoming.

Prepared by the Handicapped Children's Education Project, Education Commission of the States, 1974.

## COMMERCIAL MATERIALS

Many supplementary materials are produced each year for commercial distribution. The following list is a selection of recent products, described in terms of a content code. For instance:

*Arithmecubes (20). $3. ASMD. K-10. Ind. MG.*

*Arithmecubes* is the product name. *(20)* is the publisher number; when you scan the *Publisher's List*, which follows the list of *Commercial Materials*, and come to number 20, you find the name and address of the Milton Bradley Company, producers of Arithmecubes. *$3* is the publisher's price for this product. *ASMD* indicates that Arithmecubes' content areas are addition, subtraction, multiplication and division. Other content area abbreviations are: F (fractions); G (geometry); Ms (measurement). *K-10* indicates that this game can be used for grades Kindergarten through 10, inclusive. *Ind* indicates that Arithmecubes are for individual use. Some products may be coded grp (group), and some may be coded for both individual and group use. *MG* indicates that Arithmecubes is a manipulative game. Other abbreviations in format are: G (game); WB (workbook); and FS (film strip).

*Arithmecubes* (20). $3. ASMD. K-10. Ind. MG.
*New Mathematics* (8). $6. ASMD. 1-3. Ind. FS.

*Coordinated Cross-Number Puzzles* (18). $1. ASMD. 2-6. Ind. FS.

*Intermediate Mathematics* (11). $10. N. 3-5. Ind. WB.

*Colorfax Addition and Subtraction* (16). $48. AS. 1-4. Ind./Grp. MG.

*Step Arithmetic* (5). $4. AS. 1-6. Ind./Grp. WB.

*Big Zero* (5). $2. A. 1-5. Ind./Grp. G.

*Addition and Subtraction Wheels* (20). $4. AS. 1-4. Ind./Grp. G.

*Arithmetic Tube* (13). $9. AS. 1-3. Ind./Grp. MG.

*Math: Beginning Multiplication* (10). M. 2-3. Ind. WB.

*Exercises In Long Division* (15). $2. D. 3-6. Ind. WB.

*Dive Into Division Facts* (14). $8. D. 3-5. MG. WB.

*Mars Math Book Three* (5). $4. MD. 3-6. Ind./Grp. WB.

*Division Orbiting the Earth* (21) $6. MD. 3-6. Ind. WB.

*Number Concepts, Level 1* (4). $4. MD. 3-6. Ind. WB.

*Design by MaBill* (31). Ed. 11-10. Ind. MT.

*How Much, How Many?* (2). $4. Ms. K-1. Ind./Grp. WB.

*Measurement, Level 1 and 2* (4). $4. Ms. 1-4. Ind./Grp. WB.

*Study of Graphs, Flannel Board Kit* (14). $5. Ms. 1-5. Ind./Grp. M.

*Geometric Learning Shapes* (13). $7. G. 1-4. Ind. MG.

*Geoboard Kit* (12). $4. G. 1-6. Ind. MG.

*Poly Gons* (5). $2. G. 5-12. Grp. G.

*Fraction Chart* (13). $3. F. 2-5. Ind./Grp. M.

*Discovering Fractions* (14). $7. F. 1-4. Ind./Grp. M.

*Slide and See Metric Measurement* (20). $3. Ms. 2-8. Ind./Grp. M.

## PUBLISHERS LIST

1. Behavioral Research Laboratories, Box 577, Palo Alto, CA. 94302.

2. Benefic Press, 10300 Roosevelt Rd., Westchester, ILL. 60153.

3. Comspace Corporation, 350 Great Neck Rd., Farmingdale, N.Y. 11735.

4. Continental Press, Inc., Elizabeth, PA. 17022

5. Creative Teaching Associates, Box 293, Fresno, CA. 93708.

6. Cuisenaire Company of America, 12 Church St., New Rochelle, N.Y. 10805.

7. Educational Materials Company, 1533 S. Victory Blvd., Glendale, CA. 91201.

8. Educational Projections Corporation, Box 1187, Jackson, MISS. 39205.

9. Fearon Publishers, 6 Davis Dr. Belmont, CA. 94002.

10. Grademakers (Division of Imperial International Learning Corporation), Box 1187, Jackson, MISS. 39205.

11. Grolier Educational Corporation, 575 Lexington Ave., New York, N.Y. 10022.

12. Houghton-Mifflin Company, 53 W. 13th St., New York, N.Y. 10036.

13. Ideal School Supply, 11000 S. LaVerne Ave., Oaklawn, ILL. 60453.

14. Instructo Company, Paoli, PA. 19301.

15. Kenworthy Educational Services, Box 3031, Buffalo, N.Y. 14205.

16. Macmillan Publishing Company, 200 F. Brown St., Riverside, N.J. 08075.

17. Maflex Associates, 111 Brown Ave., Box 519, Johnstown, PA. 15907.

18. McCormick-Mathers Publishing Company, 300 Pike St., Cincinnati, OHIO 45262.

19. Midwest Publications, Inc., Box 129, Troy, MICH., 49084.

20. Milton-Bradley Company, Springfield, MASS. 01101.

21. Scott, Foresman and Company, 1900 Lake Ave., Glenview, ILL. 60025.

## BIBLIOGRAPHY


Abeson, A. and Weintraub, F. The law and that other minority, in Kreinberg, N. and Chow, S.H.L., *Configurations of change: the integration of mildly handicapped children into the regular classroom.* San Francisco: Far West Laboratory for Educational Research and Development, 1973.

Bernstein, A. A study of remedial arithmetic conducted with 9th grade students. Part 2: teaching methods and case studies. *School Science and Mathematics*, 1956, 56, 429-438.

Bernstein, A. Library research: A study in remedial arithmetic. *School Science and Mathematics*, 1959, 59, 185-195.

Borg, W.R. *The minicourse: a microteaching approach to teacher education.* New York: Macmillan Educational Services, 1970.

Brown versus Board of Education, 347 U.S. 483, 74 S. Ct. 686 (1954).

Callahan, L. Remedial work with underachieving children. *Arithmetic Teacher*, 1962, 9, 138-140.

Cruickshank, W.M. Arithmetic ability of mentally retarded children. *Journal of Educational Research*, 1948, 42, 279-288.

Dougherty, F. The akron experiment. *Arithmetic Teacher*, 1962, 9, 446-448.

Dunn, L.M. Special education for the mildly retarded--is much of it justified? *Exceptional Children*, 1968, 35, 5-24.

Erdman, R.L. and Olson, J.L. Relationships between educational programs for the mentally retarded and the culturally deprived. *MR Abstract*, 1966, 3, 311-318.

Ferrald, R.R. and Schamber, R.G. A diagnostic and prescriptive technique--*Handbook I: a mainstream approach to identification, assessment and amelioration of learning disabilities*. Sioux Falls, South Dakota: Adapt Press, 1973.

Gall, M.D. The development of mediated training programs for workers with the handicapped. Proposal submitted to DHEW, Office of Education, 1974.

Glatter, A.N. Significant variables of short-term tutoring. Doctoral dissertation (U.M. 68-9960). Detroit, Mich.: Wayne State University, 1967.

Guerin, G.R. and Szatlocky, K. Integration programs for the mildly retarded. *Exceptional Children*, 1974, 41, 173-179.

Harvey, L.F. and Kyte, G.C. Zero difficulties in multiplication. *Arithmetic Teacher*, 1965, 12, 45-50.

Havighurst, R.J. *The Public Schools of Chicago*. Chicago: The City Board of Education, Chicago, Illinois, 1964.

*Individualizing instruction in mathematics: teacher handbook*. Beverly Hills: Macmillan, 1971.

Jenkins, J.R., Mayhill, W.F., Peschka, C.M., and Jenkins, L.M. Comparing small group and tutorial instruction in resource rooms. *Exceptional Children*, 1974, 40, 245-250.

Johnson, G.O. Special education for mentally handicapped--a paradox. *Exceptional Children*, 1962, 19, 62-69.

Johnson, D. Clinical teaching of children with learning disabilities, *ACLD Journal*, Annual 5; Academic Therapy, San Rafael, California 1969, p. 245.

Kirk, S.A. Basic facts and principles underlying special education, in *Education of Exceptional Children*, National Society for the Study of Education. 49th Yearbook. Chicago: University of Chicago Press, 1950.

Macmillan, D.L. Issues and trends in special education. *Mental Retardation*, 1973, 11: 3-8.

Macmillan, D.L. Special education for the mildly retarded: servant or savant? *Focus on Exceptional Children*, 1971, 2 (9).

Newborg, J. *An evaluation of Columbus, Ohio, tutoring program for neurologically handicapped students.* Columbus Public Schools, 1971. ERIC: ED 988266.

Pace, A. Understanding and the ability to solve problems. *Arithmetic Teacher*, 1961, 8, 226-232.

Rosenshine, B. and Furst, N. *The effects of tutoring upon pupil achievement: a research review*, 1969. ERIC: ED 064462.

Siegel, E. *Special education in the regular classroom.* New York: The John Day Company, 1969.

Stowitschek, J.J. and Hofmeister, A.M. Effects of minicourse instruction on teachers and pupils. *Exceptional Children*, 1974, 40, 490-495.

Zedler, E. *Educational programming for pupils with neurologically based language disorders.* Office of Education (DHEW), Final Report. Southwest Texas State College, San Marcos, Texas, Dec. 1968.

## Suggested Reading


Birch, J.W. *Mainstreaming: educable mentally retarded children in regular classes.* Reston, Virginia: Council for Exceptional Children.

Deno, E.N. (Ed.) *Instructional alternatives for exceptional children.* Reston, Virginia: Council for Exceptional Children.

Jones, R.L., and MacMillan, D.L. (Eds.) *Special education in transition.* Boston: Allyn and Bacon, 1974.

Kreinberg, N. and Chow, S.H.L. (Eds.) *Configurations of change: the integration of mildly handicapped children into the regular classroom.* San Francisco, Ca. Far West Laboratory for Educational Research and Development, 1973.

Mann, P.H. (Ed.) *Mainstream special education: issues and perspectives in urban centers.* Reston, Virginia: Council for Exceptional Children.